NEW EDITION

GROWING HAWAI'I'S NATIVE PLANTS

A SIMPLE STEP-BY-STEP APPROACH FOR EVERY SPECIES



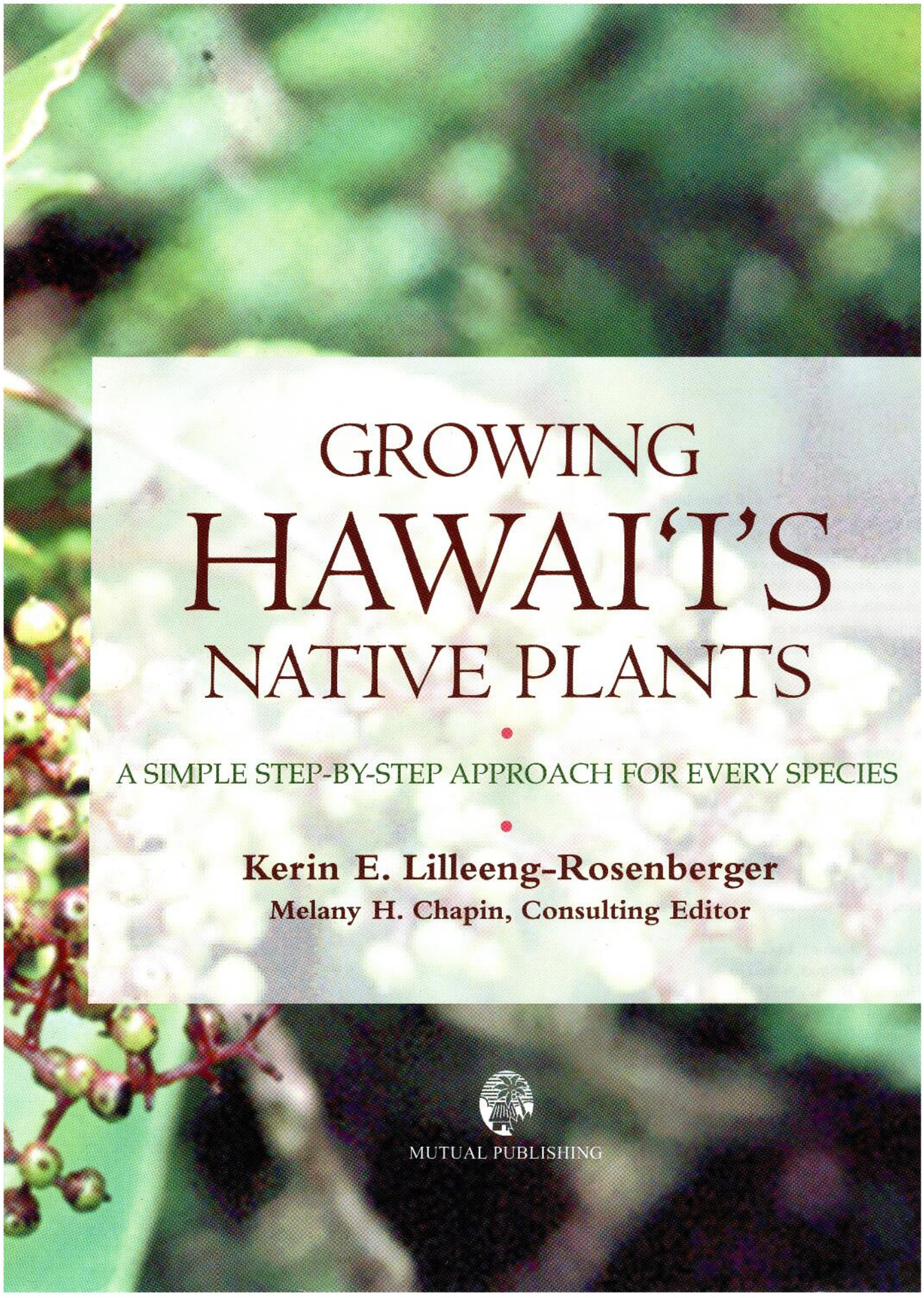
KERIN E. LILLEENG-ROSENBERGER



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Kerin E. Lilleeng-Rosenberger

Melany H. Chapin, Consulting Editor

MUTUAL PUBLISHING

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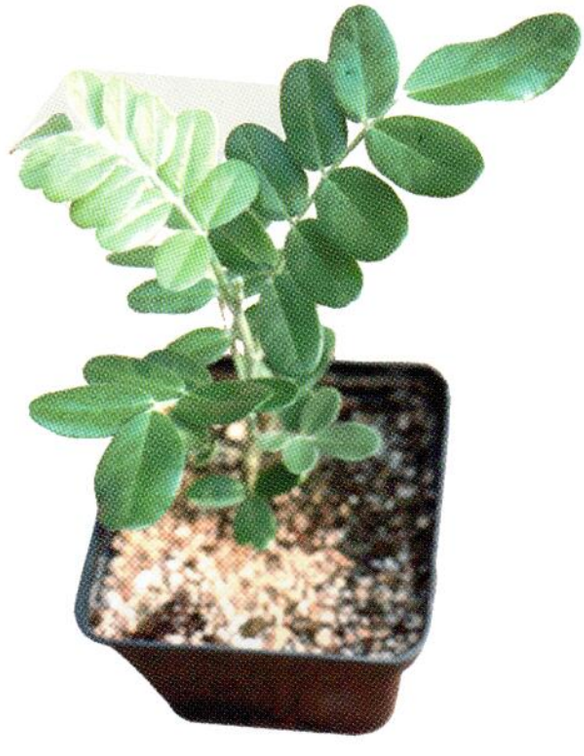
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DEDICATION

I dedicate this book to the spirit of Mother Nature,
for all of her magical creations, and to those who strive to preserve them.



'Eke bog – W. Maui — KRW

AUTHORS NOTE

While editing and updating GHNP for this third edition, I'm continually saddened by the story of the demise of the many unique native Hawaiian plants. They are declining from the lack of knowledge and respect of the existing native habitats in Hawai'i and around the world. Entire ecosystems have been and are being altered from agriculture & cultural practices.

It is time to hold the worst offenders financially accountable for restoring what is restoreable and stopping future blatant destruction of what is left. When the planet is sick so are we.

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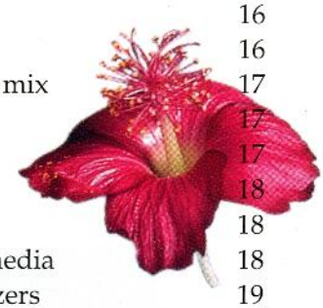
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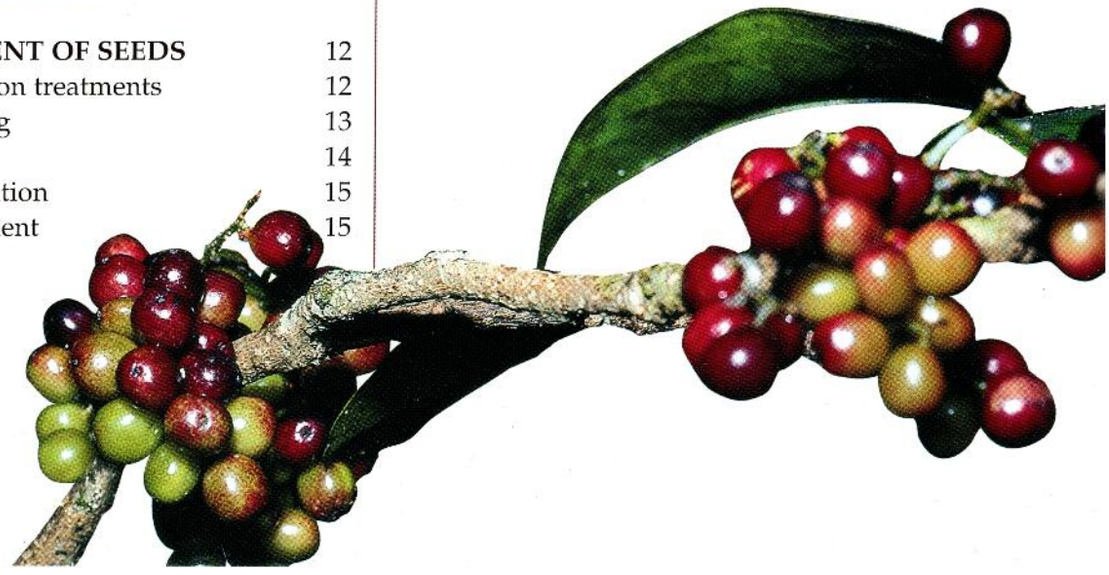
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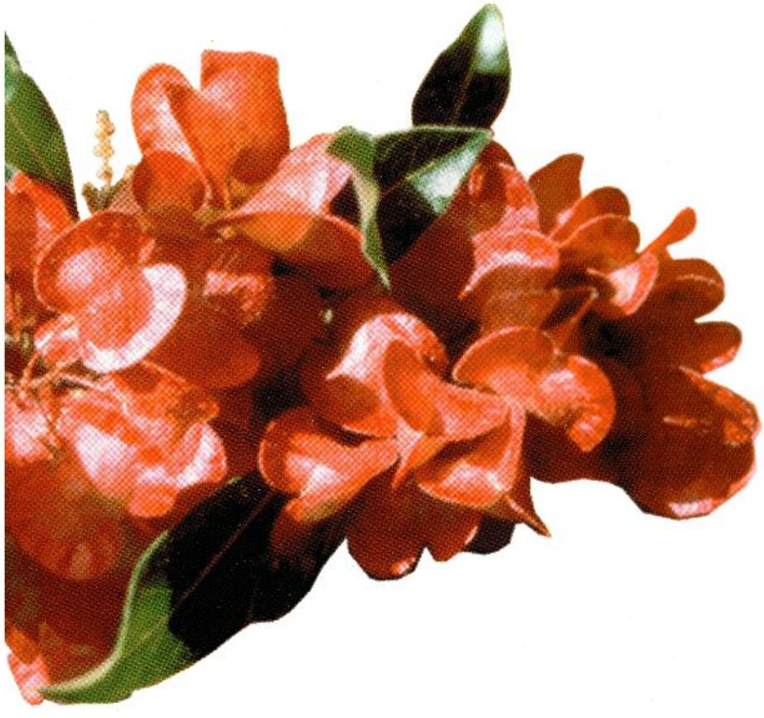
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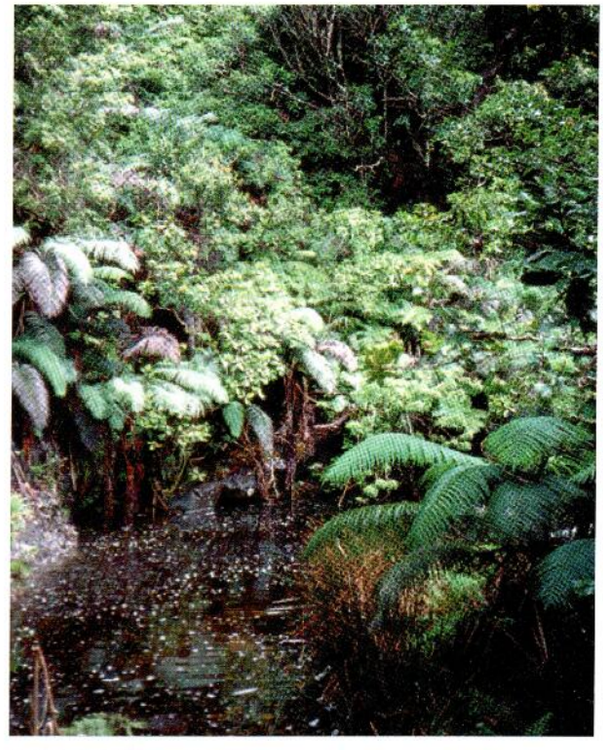


FOREWORD

There can be few places on earth with a greater need for conservation of the native flora, and for propagation program for the rare species, than the Hawaiian Islands. During a two-year period holding the McBryde Chair at the National Tropical Botanical Garden in Hawai'i, I had the opportunity to become familiar with, and concerned about, the fascinating flora of the islands. The evolution of a native flora of 1,029 (1,175 2012 update) species of flowering plants from the original approximately 270 arrivals makes Hawai'i a living laboratory for evolutionary studies. The real tragedy is what has happened to these plants through the destruction of habitat and colonization by alien invasive species. So many of the surviving native species are reduced to so few individuals that their future is uncertain. This makes a book devoted specifically to the propagation of native Hawaiian plants most welcome and useful.

The author has accumulated extensive knowledge on the propagation of Hawaiian flowering plants and ferns, and has cultivated an impressive 821 of the 1,191 (1,386 2012 update) (Wagner et al. 1999) native plant species of Hawai'i. Whether common or rare, the plant is included here. This book also shows the value of the role of botanical gardens in conservation, for much of the author's work was carried out in the nurseries of the National Tropical Botanical Garden in the Lawā'i valley of Kaua'i.

It is essential for conservation to propagate and increase the population of rare species wherever possible so that more individuals can be reintroduced into the wild. This manual of propagation covers in detail the many techniques used to secure germination of seeds or to produce cuttings. In a few cases where these methods do not work, the author has even resorted to grafting. The Pteridophytes or ferns are discussed separately, since propagation from spores is quite different from seeds. Part One contains a great deal of general information about the propagation of plants, and Part Two provides specifics for individual species and families. In addition to direct information about propagation, Part Two includes a wealth of other information about each group discussed, and thereby increases the potential interest and value of this volume.



Kapolei, O'ahu — KRW

There are many books about the propagation of plants from temperate regions, but relatively few about tropical plants. Since relatives of the species treated here appear in many parts of the tropics, this book is likely to be of use to propagators of tropical plants far beyond the shores of Hawai'i. Here is a volume that will be of considerable use to conservationists and gardeners alike, whether amateur or professional.

Professor Sir Ghillean Prance, FRS, VMH
Scientific Director, The Eden Project and
former Director, Royal Botanic Gardens, Kew

PREFACE

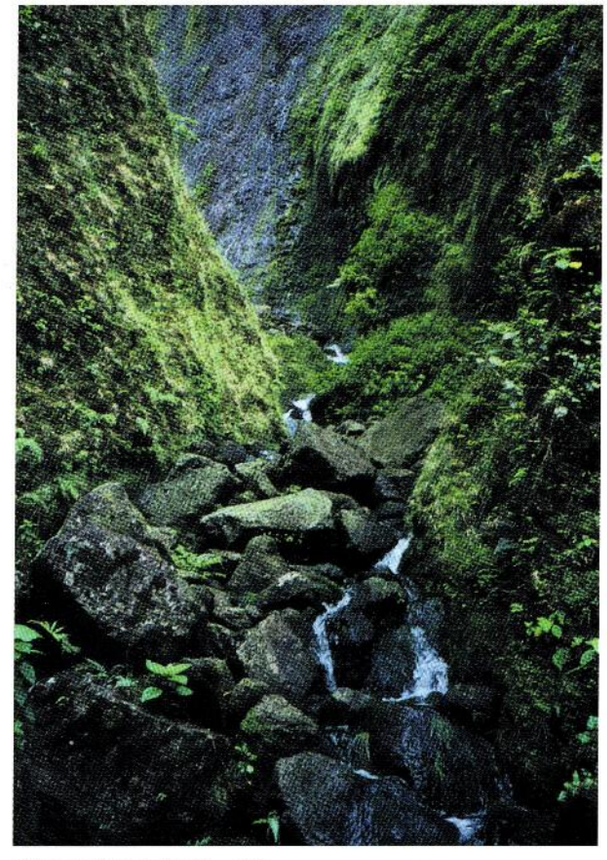
In the winter of 1968, I moved to Hilo, on the island of Hawai'i, from Detroit, Michigan. I noticed immediately that the air was delicately scented with the fragrance of flowers. The various shades of green were unlike anything I had ever seen, and the flowers were of every color in the rainbow. I knew then that my new home was unique.

I wanted to know how to grow everything I saw! Plants have always fascinated me. My first experience with Hawaiian horticulture was growing ti (*Cordyline*) plants and *Dracaena* cuttings in gallon jars of water for houseplants, not knowing they were going to develop roots.

Nearly twenty years later, in 1986, I started volunteering at the nursery of the National Tropical Botanical Garden (NTBG) on Kaua'i, where unusual plants from around the world are grown, along with an array of local favorites for fundraising plant sales. The proceeds from these sales were used to buy more nursery supplies and to fund special projects at the garden. After a year or so of being taught the fundamentals—sowing seeds, starting cuttings, air layering, and grafting—I was put in charge of plant propagation.

I wanted to learn more about the plants around me: their names, how to identify them, and which ones were native to the Hawaiian Islands. Enrolling in courses in Tropical Plant Identification and Plant Propagation at Kaua'i community college, I learned about introduced plants and their origins. Soon, I realized that a lot of the plants I had thought were native to Hawai'i were not.

At the same time, I volunteered to help grow native Hawaiian plants for the Plant of the Month program, a community outreach program initiated in 1988 through the NTBG visitor center. This program sought to increase awareness of native Hawaiian plants by providing a free plant, along with a plant information sheet to local gardeners, and following up with a survey to gauge gardeners' success growing their adopted native plants. With my knowledge of the fundamental principles involved in plant propagation, I came up with simple methods for growing healthy native Hawaiian plants for the give-away.



Waihee Valley, Maui—SP

In October 1989, an opportunity came my way through the Hawai'i Plant Conservation Center. It was a program that was established at NTBG, funded by a grant from the John D. and Catherine T. MacArthur Foundation: a resource center for information and for understanding how to propagate native Hawaiian plants.

I was hired and put in charge of the new native Hawaiian plant nursery, built with the MacArthur grant money. The nursery, an open-air shade house, was located in the Lāwa'i Valley of



Native flowers of the Malvaceae family growing in Kerin's yard—KLR

the island of Kaua'i. Even though the nursery was at sea level, I grew plants from all of the distinct Hawaiian plant communities from coastal to alpine vegetation zones.

I was provided with a variety of native seeds, but had neither instructions nor reference guides to follow; the majority of these plants had never been grown in cultivation before. I found that the propagation of native Hawaiian plants was not well documented or understood. There were many myths, but few reliable sources of information.

For more than ten years, I experimented with different potting mixes, seeds, and cutting treatments, along with many other types of plant materials. I kept detailed records, which helped identify what had contributed to the successful results. Eventually, the knowledge I had gathered filled fourteen notebooks.

From 2000 through 2002, I worked for the Research Corporation of the University of Hawai'i under the direction of the Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW) as a research horticultural specialist responsible for propagating rare and endangered Kaua'i plants in a mid-elevation nursery site at 3,000 feet (1,000 m) in Kōke'e, and at the DOFAW Līhu'e base-yard. We outplanted these threatened species into enclosures erected in various vegetation zones on Kaua'i. I had the opportunity to grow many species that had struggled at NTBG's lower elevation nursery, yet thrived in the cool, misty environment of Kōke'e and twelve other outplanting sites. With the help of colleagues and volunteers, many of these species were successfully outplanted. In the enclosures, the native plants were safe from grazing or browsing animals. All in all, we propagated and outplanted over 126 species, which thrived within these safe havens. I had the opportunity to participate in the complete cycle, from collecting seed to outplanting in the wild, and saw many of these plants mature to flower and fruit.

I would like to recognize myself and others born with dyslexia (Definition: A learning disorder marked by impairment of the ability to recognize and comprehend written words). Undetected in the 1950's, I was labeled "a slow learner" and held back in first grade for lacking in reading and writing skills. My challenges dealing with dyslexia have compelled me to become patient and tenacious which has helped me to overcome most obstacles in my life, like writing and editing this book!

I thought that writing a book was far beyond my capabilities and, even now as I write this, I am struggling with this very time-consuming process. And I am grateful for modern-day spell check! Growing and caring for plants and animals in nature has always been my greatest passion and salvation.

This book presents the knowledge I have accumulated over the years. I want to share the methods that have brought me successful results. I also want to make it fun and simple to grow and care for Hawai'i's native plants in the landscape, and where possible, I have given priority to effective low-tech and low-cost methods. I hope you will find this volume helpful and informative.

Acknowledgments

I want to sincerely thank George Rosenberger, my loving husband, for his endless support and positive encouragement throughout the entire process of this book.

I give special thanks to Michael and Noreen O'Toole for the generous contribution that made it possible to have the many colored images in this book, representing all the uniquely beautiful Hawaiian genera.



Michael and Noreen O'Toole

My warmest Aloha to Lynette and Marty Troutner for their time and excellence in assisting with editing this third edition.

This research was made possible through the generous donations of the John D. and Catherine T. MacArthur Foundation. Appreciation for funding is also extended to the Department of Land and Natural Resources, Division of Forestry and Wildlife; the United States Fish and Wildlife Service; and the Center for Plant Conservation. These studies would not have been possible without the access and permits provided by the state of Hawai'i, Hawai'i State Parks, The Nature Conservancy of Hawai'i, and many private individuals, organizations, and landowners. The Bernice P. Bishop Museum Herbarium and the United States National Herbarium, Smithsonian Institution (US) also contributed to the success of these efforts. The National Tropical Botanical Garden (NTBG) enabled the Hawai'i Plant Conservation Center and the continuation of this study to succeed. Many individuals and conservation partners contributed to the success of this project, and the list below is not complete. A debt of gratitude is extended to the following individuals, listed alphabetically, who played key roles in my research on the propagation of native Hawaiian plants.

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I want to express my deepest appreciation for the time and effort of these kind people, who generously contributed to the beautiful images in this book. Without their efforts, my quest to include an image representing every plant genus both endemic and indigenous to the Hawaiian Islands would not have been possible.

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Thanks also to the Department of Land and Natural Resources, Division of Forestry and Wildlife for the unforgettable experience of propagating, and outplanting in the wild, these unique plants of Hawai'i.

The DOFAW crew
Galen Kawakami
Craig Koga
Edwin Pettys
Augusto Ruaboro
Stafford Soto
Alan Silva

INTRODUCTION

WHAT ARE ENDEMIC HAWAIIAN PLANTS, AND HOW DID THEY GET HERE?

The Hawaiian Archipelago, nearly 2,500 miles from its nearest neighbor, is the most isolated landmass in the world ((Plate 1) p.409). Unlike many other islands and island chains, which drifted away from their respective continents, geologic evidence indicates that the Hawaiian Archi-pelago is the result of volcanic activity beneath the seafloor, and has never been connected to any other land mass. So how did Hawai'i's unique flora and fauna arrive, and how did they become so well adapted to these isolated islands of lava?



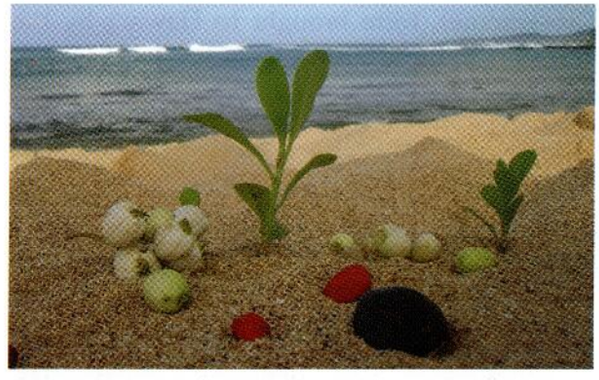
Wind dispersed seeds—KLR

WIND

Since the islands arose from the sea six million years ago, seeds and spores have arrived regularly. Many seeds, spores, and pollens are tiny and dust-like, and can drift airborne in the jet stream for exceptionally long distances. Surviving the freezing temperatures of the high jet stream, ferns, lichens, mosses, and even some flowering plants arrived in this fashion. An example is the ōhi'a lehua (*Metrosideros polymorpha*), which is a pioneer species, usually the first to become established on new lava flows along with ferns. Ōhi'a lehua seeds are still dispersed in this way and, unfortunately, so are many of the exotic plants that have more recently become naturalized and weedy in Hawai'i.

WATER

Some of Hawai'i's native plants arrived floating in ocean currents. For this rare event to be possible, the seeds or plant parts must be able to float for long distances in seawater without germinating or losing their viability. Beach plants are the best example of this special adaptation of



Wiliwili, beach naupaka and *Mucuna* seeds (wave dispersed)—KLR

buoyancy: some of the fruits contain corky materials (*Scaevola* sp.) or trapped air, while others have small coarse hairs on their seed coats called tomentose (for example, *Gossypium tomentosum*), allowing them to float. It is also believed that plants with individual seeds that could not float arrived by a process called rafting, in which great storms or other events uproot the entire plant, which then drifts in large vegetative mats to a new home. Some insects and small animals may have also arrived on rafting plants.



Kaua'i's blind cave wolf spider with babies on her back—KLR

WING

Birds, responsible for bringing 39 percent of Hawai'i's endemic flowering plants to the islands, are the vehicles for the most incredible feat of seed dispersal: arrival on the wing. The seeds may have been stuck in mud on their feet, small barbed or sticky seeds may have attached to their bodies, or seeds may have been carried in their stomachs and excreted on arrival. Many of the small, seeded, wet-forest plants, whose fruit textures are still attractive to Hawai'i's native birds (Campanulaceae, Gesneriaceae, Droseraceae), were brought to Hawai'i by the ancestors to these birds.



Koloa ducks (wing dispersed)—KLR

Once the seeds arrived in the Hawaiian Islands, by wind, water, or wing, their biggest challenge still awaited them: growth and self-regeneration.

Many plants did adapt, evolving from somewhat small numbers of original immigrants, in isolated niches, and with very limited genetic material. In fact, it is thought that the 1,029 (1,175, 2012 update) known flowering plants endemic to Hawai'i evolved from 270 original colonists (Wagner, W. L., et al. 1990). These new species coevolved in elegant equilibrium, losing chemical and mechanical defenses against grazing insects and animals that did not exist in the new environment. Instead they developed symbiotic relationships dependant on new species for food, pollination, and seed dispersal.

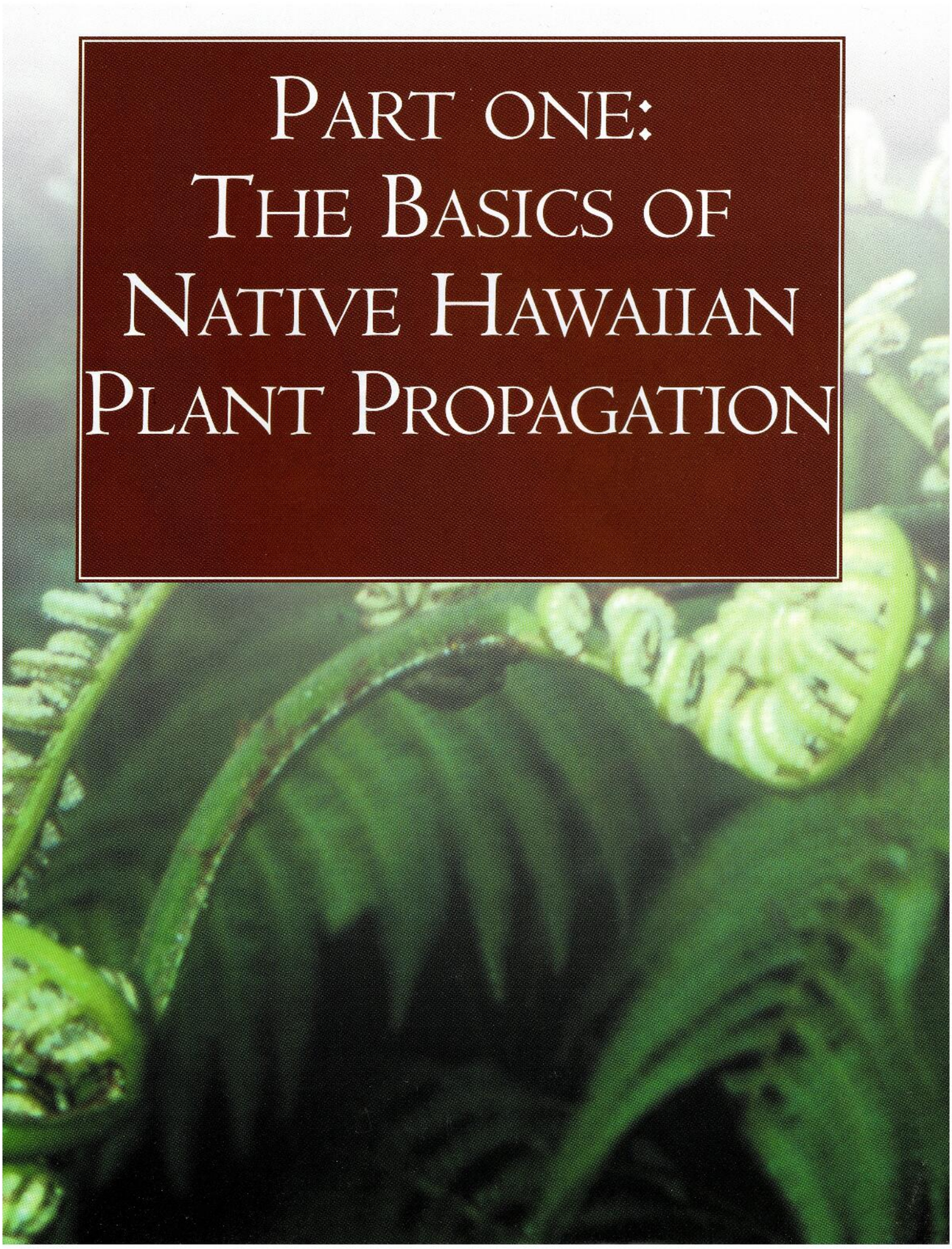
Recent fossil evidence indicates that the native lowland species stopped claiming new territory after human contact, around 400 AD (Burney et al. 2001), a fact often attributed to the introduction of the rat and, eventually, other grazing animals. Since the arrival of humans to the islands, 15,000–20,000+ and counting new plants have been introduced, along with numerous insects (increasing 20–30 percent per year) and animals. Many of these exotic plants, insects, and animals are so aggressive that Hawai'i's endemic species are losing the battle, becoming endangered or even extinct as they fail to produce seedlings and die out. Plants and seeds are being eaten by insects, rats, goats, and deer; pigs destroy seedlings while digging for food. Habitat destruction by humans and animals alike is on an enormous scale; its impact on the native plants has been devastating and almost incalculable.



Goats Kokee, Kauai—KLR

Fortunately, landscapers, home gardeners, and public educators in Hawai'i have recently begun to take an interest in Hawai'i's priceless biological heritage. Hawai'i's children and adults are learning more about these plants and their amazing and unlikely journey. Almost 95 percent of native Hawaiian plants and animals occur nowhere else in the world, and Hawai'i's long isolation has meant that even today it has the highest percentage of endemics (90 percent endemic flowering plants) in the world per square mile of landmass. These facts alone should justify a great respect for these unique treasures of the Hawaiian Archipelago.

By writing this book and sharing over a decade of experience growing native Hawaiian plants, I hope to simplify the subject and make it enjoyable. My reward will be to see these beautiful plants, well adapted to Hawai'i's weather and soil, thriving in gardens, towns, and schoolyards across the state. What could be a better plant for our landscaping projects than one that has spent hundreds of thousands of years evolving in Hawai'i?



Part one: The Basics of Native Hawaiian Plant Propagation



Native seeds collected at NTBG — DR

Seed Preparation



Of the more than 310,000 flowering plant species in the world (Prance et al. 2000), 1,029 are native to Hawai'i (Wagner et al. 1999) (1,175, 2012 update). There are more than thirty different types of native fruits and an equally diverse assortment of seed forms. The pericarp, or outer covering of the fruit, is the mature ovary and consists of the outer layer (epicarp), middle layer (mesocarp), and inner layer (endocarp). The seed is the mature ovule, and is made up of the seed coat (testa), enclosing the endosperm — the food for the new seedling — and the embryo, which eventually becomes the seedling. Fruits take diverse forms to utilize successful strategies to disperse or travel, or in some cases to stay close to the parent (Carlquist 1980). Fruits also have mechanisms to protect the embryo within the seed from animal digestion, and methods to cope with varying seasonal changes in rainfall and periods of drought. Some are even effectively scarified and dispersed by passing through the digestive tract of a bird. This extensive diversity in fruit and seed structures requires different methods of collecting, cleaning, storage, and treatments for successful germination. Below are general guidelines for the various kinds of fruits and seeds you will encounter. Specific methods are included in the family and genera profiles.

COLLECTING SEEDS



***Abutilon menziesii* x *A. eremitopetalum* hybrid — KLR**

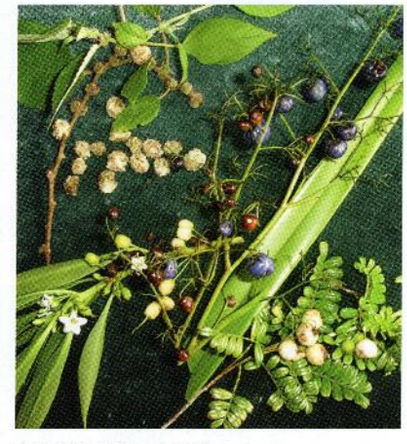
Fruit collection is one of the most important aspects of successful seed germination. If seeds are gathered when their embryos are insufficiently developed (immature), germination is greatly impaired. The seed is prone to be thin, light in weight, shriveled, poor in quality, and short-lived, producing a weak seedling or none at all. Ideally, seeds should be gathered from healthy, vigorous plants that are not stressed by drought or other unfavorable climatic conditions that might impair viability and/or increase disease before and during harvest. At the National Tropical Botanical Garden (NTBG) nursery, I grew native Hawaiian plants from all of the major islands in close proximity to each other. Often, these plants would cross-pollinate freely and would readily produce seeds. I tried to grow many of these crossbred seeds to see if they were viable or not, and they sometimes produced hybrid species. The *Abutilon*, *Bidens*, *Tetramalopium*, and *Schiedea* are some of the genera that produced hybrids within one generation. I have a beautiful cross between *Abutilon menziesii* and *Abutilon eremitopetalum*. The plant has characteristics of both parents, and seeds produced by the hybrid stay true to the hybrid and do not revert back to either of the original parent species. To ensure a pure strain of seeds, collect them from the wild or from a controlled, pollinated plant, or use a clone (see page 20: Clonal Propagation).



***Alphitonia ponderosa* seeds shriveled, insufficiently developed — DR**

FLESHY OR PULPY FRUITS

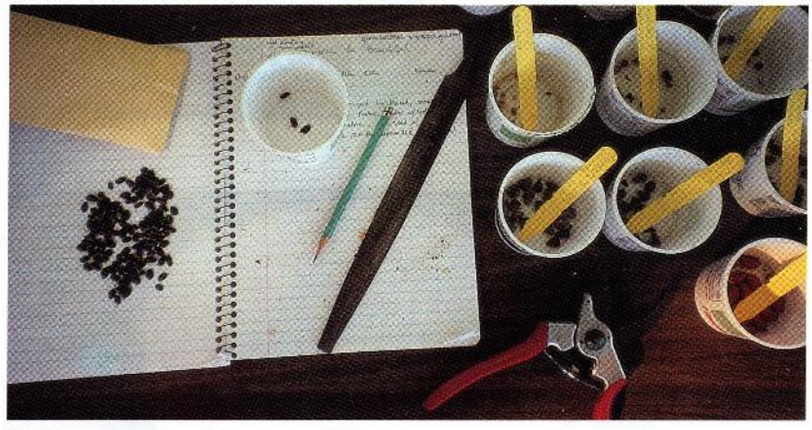
Collect fruits when they are as ripe as possible. Pulpy or fleshy fruits usually become soft when ripe and may change in color from green to white, black, orange, red, yellow, or other colors, depending on the species. Ripe fruits are easier to remove from plants, and will often fall off into your hands. Use plastic bags to help keep the pulp soft for easy removal until cleaning. If fleshy pulp is allowed to dry around the seed, it may create a very hard covering that will inhibit germination, as I have found to be true with sandalwood seeds.



Pulpy seeds — KLR

DRY FRUITS (SEEDS)

Dry fruits have no pulp and are definitely dry at maturity (such as achenes, pods, and capsules). Try to collect these fruits on a dry day and keep them in a dry paper bag. Moisture can cause dry fruits to mold or rot and lose their viability. For these types of fruits, the drier the seed coat, the easier they are to clean.



Keeping records and labeling—MC

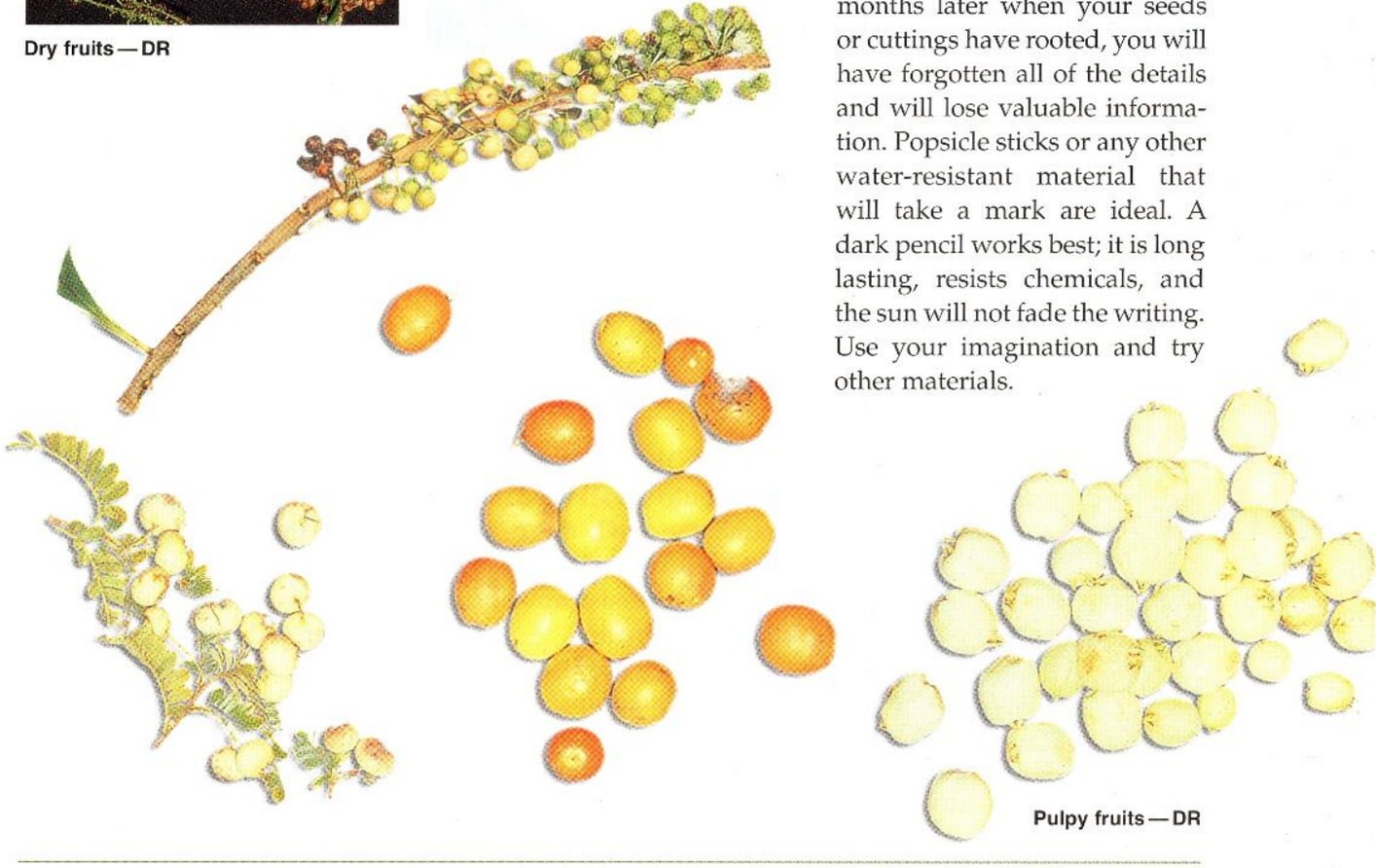


Dry fruits—DR

KEEPING RECORDS AND LABELING

It is important to keep track of what you have collected, when it was collected, where, and by whom. This information can be important later to those who have questions and may want to contact you.

Label your seeds, cuttings, air layers, and grafts with their species name, what treatments were used or not used, along with collection dates, date started, date germinated, what island they came from, and any other relevant information. If the information is not written down and attached to the plant, three months later when your seeds or cuttings have rooted, you will have forgotten all of the details and will lose valuable information. Popsicle sticks or any other water-resistant material that will take a mark are ideal. A dark pencil works best; it is long lasting, resists chemicals, and the sun will not fade the writing. Use your imagination and try other materials.



Pulpy fruits—DR

CLEANING SEEDS



Cleaning seeds — DR

A fruit includes the seed(s) and the coverings, which can protect, disperse, and also inhibit germination of the seed(s) it envelops. The pericarp (fruit outer layer, middle layer, and endocarp) encase the seed(s). Although fruits are very diverse, the pericarp must be cleaned away before sowing or storage.



Bug damaged seeds — KLR

Remove the surrounding pulp, capsules, pods, or other encasings, which can harbor strong germination inhibitors. They can also hold insects that will damage the seeds. Cleaning the pericarp away can help prevent the seeds from becoming spoiled, eaten, or diseased.

FLESHY OR PULPY FRUITS

If the pulp is allowed to dry around the seed, the resulting hard seed covering is likely to increase the seed dormancy and inhibit germination.

Large to medium seeds: To clean large to medium size fleshy seeds such as *Scaevola taccada*, *Wikstroemia*, or *Osteomeles*, first soak the seeds for an hour in a bowl of water to soften the pulp, if it is not already soft. The number of seeds you want to clean will determine the size of the bowl. Massage the fruits by hand, separating the pulp from the seeds. Pour off the floating pulp, then add more water and repeat this process until all of the pulp is gone. The heavier (viable) seeds will sink to the bottom of the bowl. The floating (non-viable) seeds can be poured off at the same time. Remember that some viable seeds will float at first, and then sink after a period of time (one to six hours). Seeds with corky or fuzzy coats will naturally float, since flotation in water is their dispersal mechanism. Most of these species are beach plants, such as *Myoporum*, *Scaevola*, and *Ipomoea*, but they will still benefit from being soaked.

Small seeds: Small pulpy fruits, like those of the *Cyrtandra*, *Cyanea*, *Clemontia*, or *Lobelia*, are mostly from wet-forest plants that may have been carried to the Hawaiian Archipelago by birds, within mud on their feet, or in their stomachs. Use a strainer with a bowl of water. First, place the fruits in the strainer and put the strainer in the bowl of water. Rub the fruits against the strainer. This dislodges the seeds. The tiny seeds will fall through the strainer holes and into the bottom of the



Manually cleaned seeds — KLR

bowl. Pour off any floating pulp. Place a paper towel in the pulp-free strainer and pour the remaining water (with seeds) into the paper towel. Many alternative methods to the strainer and bowl exist, such as using an electric mixer or a blender with rubber blades, but the method given here is the simplest and works well without electricity. Let the seeds air-dry for a day before sowing. This will cut down on diseases that may reduce the effectiveness of germination.

DRY FRUITS (SEEDS)

Seeds that are from dry, dehiscent fruits such as grasses, follicles, capsules, and pods also have pericarps (seed coverings) that are dry at maturity. After collecting dry fruits, keep them dry. Leave them out at room temperature to air-dry, or in a dry paper bag. For smaller fruits, cleaning methods are the same as for small pulpy fruits except there is no water involved in the process. Be sure to choose a strainer that matches the seed size. Place the dry fruits into the strainer, then set the strainer into a bowl and carefully rub the fruits so that the seeds are dislodged and fall through the strainer into the bowl. This method is useful for small seeds in papery capsules such as *Dodonaea* and *Poaceae*.

CLEANING SEEDS MANUALLY

It is easier to manually remove large seeds in capsules or pods such as *Erythrina*, *Mezoneuron*, and *Canavalia*. Tools (for example, nail-clippers, a pocketknife, a hammer) and other implements can come in handy. Be very careful to avoid damaging the embryos. When you have collected and cleaned your seeds, they are ready for sowing or storage.

STORING SEEDS



Seed desiccation chamber—DR


Seeds storage in refrigerator—KLR

Seeds must be cleaned before storage. This includes the removal of any pulp, capsule, or other encasings, followed by air-drying. Germination inhibitors can be present in the pericarp, and seed-eating insects may be hiding in the capsule. Low moisture content in seeds during storage is the most important condition to maintain and monitor. Do not store seeds in plastic bags. Instead, I use sealed envelopes kept dry in storage containers in the refrigerator.

The NTBG conducted germination tests on the viability of seeds stored between one and eight years in desiccation chambers, using silica gel to maintain a relative humidity of 25% at room temperature. The results were interesting. In general, seeds that occurred naturally in dry environments with dry seed coverings demonstrated high viability percentages after being stored in desiccation, whereas seeds from naturally moist environments, with fruity pulp coverings and softer seed coats, had very low viability or lost all viability after desiccation and storage.

DESICCATION

If seeds can tolerate desiccation without losing their viability, place them with the desiccant in an airtight container, storing in a cool, dry place. Try to maintain a relative humidity of 25%. Some of these seeds, such as *Schiedea*, germinate even better after desiccation.

Asteraceae: *Argyroxiphium, Bidens, Hesperomannia, Dubautia, Lipochaeta, Tetramolopium,* and *Wilkesia.*

Amaranthaceae: *Achyranthes* and *Charpentiera.*

Carophyllaceae: *Alsindendron, Schiedea,* and *Silene.*

Cyperaceae: *Carex, Cladinm, Cyperus, Fimbristylis,* and *Gahnia.*

Poaceae: *Cenchus, Eragrostis, Heteropogon, Ischaemum, Panicum,* and *Poa.*

TEMPERATURE

Seeds with hard seed coats in the legume family (Fabaceae) have high viability when stored in airtight containers without desiccants. They can be stored in the refrigerator or at room temperature in a dark, dry place. It is still important to keep out moisture so they will not germinate or rot.

Fabaceae: *Acacia, Caesalpinia, Canavalia, Erythrina, Senna, Sesbania, Strongylodon, Vigna.*

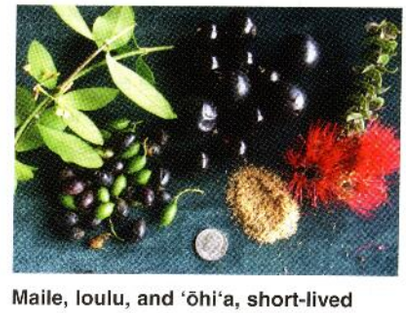
SHORT-LIVED SEEDS

Some seeds from wet-forest areas are meant to germinate right away and are short-lived. Often the very small seeds with only a soft seed coat or larger seeds like the native palm (*Pritchardia*), have no protective, hard seed coat and no dormancy capabilities. They will not tolerate storage and need to be sown immediately after cleaning. Otherwise they will quickly lose their viability.

Apocynaceae, Arecaceae, Begoniaceae, Campanulaceae, and Violaceae.

The requirements for seed storage of the Hawaiian endemic species are not yet fully understood and need further research.

(See opposite page for examples and images of Genus and Families.)

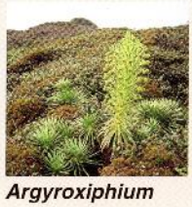

Maile, loulu, and ʻōhiʻa, short-lived seeds—KLR

DESICCATION

FAMILY & GENUS:

Asteraceae

Argyroxiphium
Bidens (8 yrs)
Hesperomannia
Dubautia
Lipochaeta
Tetramolopium
Wilkesia (8 yrs)


Argyroxiphium


***Bidens* (8 yrs)**


Hesperomannia


Lipochaeta


***Wilkesia* (8 yrs)**

Amaranthaceae

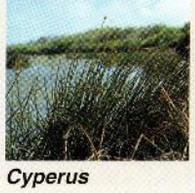
Achyranthes (8 yrs)
Charpentiera


Achyranthes


***Charpentiera* (8 yrs)**

Cyperaceae

Carex
Cladium
Cyperus
Fimbristylis
Gahnia

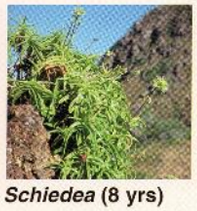

Cyperus

Caryophyllaceae

Alsinidendron
Schiedea (8 yrs)
Silene


Alsinidendron


Silene


***Schiedea* (8 yrs)**

TEMPERATURE

FAMILY & GENUS:

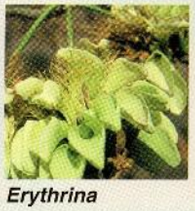
Fabaceae

Acacia
Caesalpinia
Canavalia
Erythrina
Senna
Sesbania
Strongylodon
Vigna

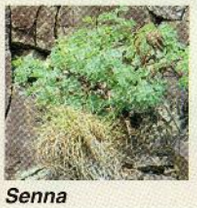

Acacia


Caesalpinia


Canavalia

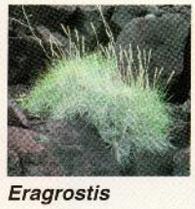

Erythrina


Sesbania


Senna

Poaceae

Cenchus
Eragrostis
Heteropogon
Ischaemum
Panicum
Poa


Eragrostis


Poa

SHORT-LIVED SEEDS

FAMILIES & GENUS:

Apocynaceae
Arecaceae
Begoniaceae
Campanulaceae
Violaceae

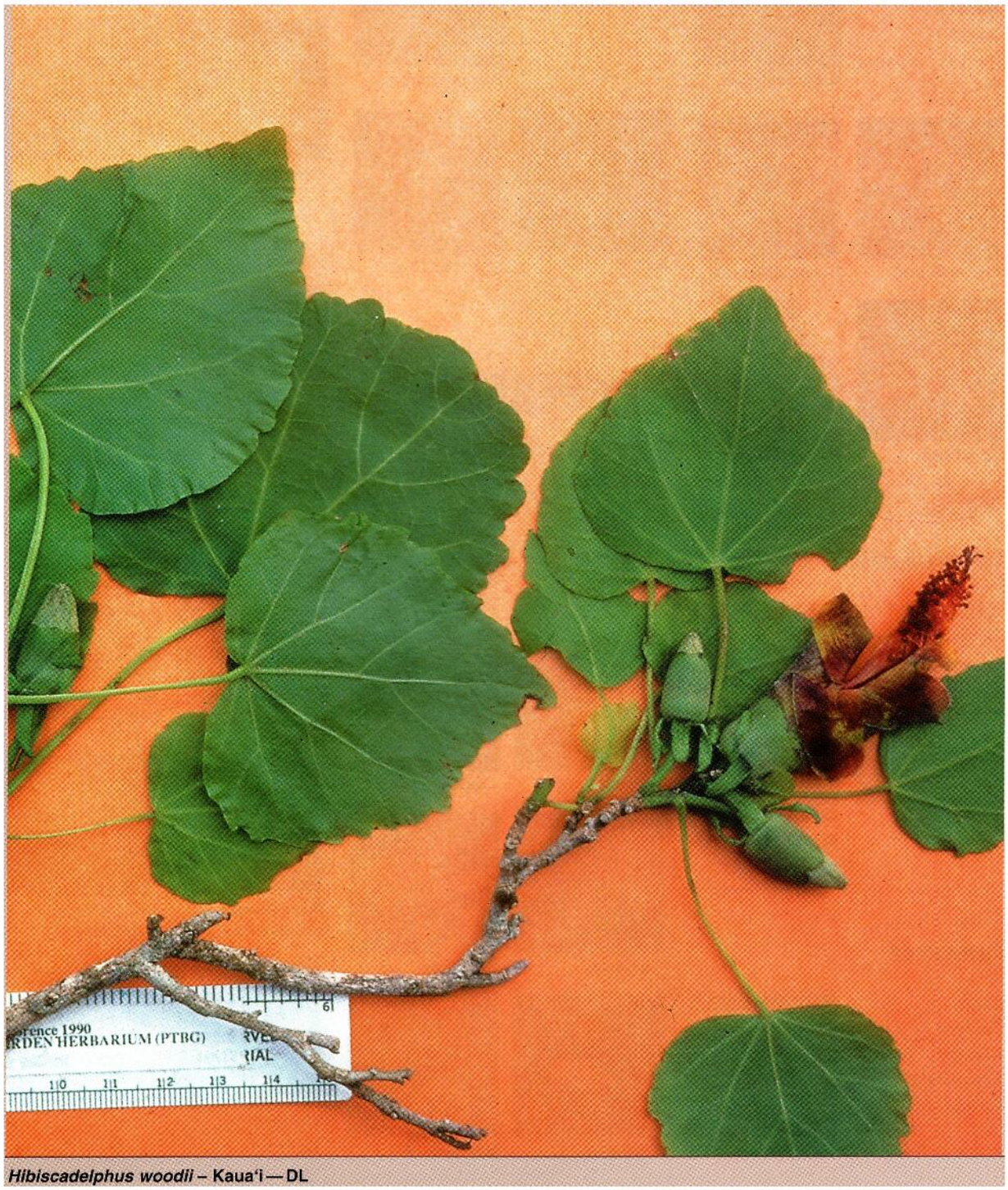

Apocynaceae
Alyxia


Arecaceae
Pritchardia


Begoniaceae
Hillebrandia


Campanulaceae
Brighamia


Violaceae
Viola



Hibiscadelphus woodii – Kaua'i — DL

Methods of Propagation

Most books on propagation apply only to temperate zones and discuss such topics as double dormant embryos, winter callusing, stratification, heating pads, and enclosed glass greenhouses with elaborate heating and cooling systems. They include the basic methods on growing just about any plant that you desire, and all of this information can be found in any reliable propagation book. However, these procedures are not usually applicable when growing tropical plants in a tropical region. The growing seasons in Hawai'i are not limited, and freezing temperatures are not a consideration.

I have propagated and grew over 821 of the 1,191 (1,386, 2012 update) species native to the Hawaiian Islands, from the common species to some of the most endangered plants in the world. More than once, I worked with only one seed or cutting from the last plant known to exist in the wild. These are nature's children, and they need extra protection in order to grow up healthy and strong—but anything special is worth a little extra time and effort. That is how I treat these plants, and it may be a contributing factor to the success I have in growing these unique and threatened *Keiki o ka 'āina* (Children of the land). The methods provided here are proven to work and are necessary in order to propagate and grow some of the more threatened plants native to Hawai'i.

NTBG collectors brought in material from all of the main islands; the material was immediately given a unique accession number, which links the plant to its collector, date, and origin. Since I received so many different kinds of seeds and other materials in large batches, I began to notice that in general the seeds from the same family behaved similarly (for example: drupes, pulpy or dry seeds, or pods) and needed to be cleaned, pretreated and sown in similar ways. This was also true to the generic level.

I have not had success with every species I have received. Some of the native plants that occur in small non-viable inbreeding populations are incapable of regeneration, and the seeds and cuttings failed to germinate or root. These plants need more work done on them; micro-propagation may be their only hope. *Hibiscadelphus woodii* is a good example. Some plants may have a mycorrhizal fungi dependency. These plants need a particular fungus to survive and for their propagation. Mycorrhizal fungi exist in healthy soil and have a symbiotic relationship with roots of certain plants, such as native Orchids (Auge 1988).

In Part Two of this book, I will focus on general propagation methods of every endemic (native only in Hawai'i) and indigenous (native to Hawai'i and elsewhere) plant occurring in the Hawaiian Archipelago. The plants are organized by family and genus; the propagation methods are similar within genera. Specific methods are discussed by genus.

PRETREATMENT OF SEEDS



Cleaned native seeds — KLR

There are three factors in the successful germination of seeds. These are (1) seed viability, (2) removal of barriers to dormancy, and (3) fulfillment of the environmental needs of the seed. First, the seeds must be viable, with live embryos that are capable of germination. The collection of mature, ripe seeds from healthy plants that are not drought-stressed or stressed in any way will help ensure healthy embryos with sufficient amounts of stored food, capable of germination.

Second, seeds must be non-dormant, with no dormancy-inducing barriers present, whether they be physiological, physical, or chemical. Pulpy fruit and some thick seed coverings contain or create these barriers—hence the importance of cleaning seeds before sowing. If the seeds are dormant, the dormancy can be broken by various treatments described below. Third, seeds will not germinate or grow unless the environmental conditions normally required for growth are present. These include the proper moisture, temperatures, oxygen supply, and light levels. Seeds have strong survival tendencies and will not germinate unless these needs are met. In a controlled nursery setting, these environmental conditions can be created.

PREGERMINATION TREATMENTS

Pregermination treatments help the seeds overcome any dormancy-inducing characteristics in the seed coat, and stimulate faster germination. Tropical plants, which have evolved in a warm climate, have different germination requirements than temperate

plants. Generally speaking, native Hawaiian seeds do not require treatments that are often practiced in the temperate zones. For example, in temperate areas, stratification, which is a period of seed chilling, is often required for seeds that are accustomed to freezing winter soils. Similarly, the use of heating pads to help promote germination by keeping the seed mix warm is standard practice in colder regions but is not normally necessary for native Hawaiian plants.

Drupes have stone-hard endocarps (seed coat coverings) and are the most difficult seeds of the Hawaiian species to grow. These hard seeds need to be penetrated with water in order for the drupe to crack open along the seam for germination, like a peach seed does. Some of the Hawaiian plants with drupe seeds include:

Santalum
Elaeocarpus
Pteralyxia
Ochrosia

These are a few of the most troublesome genera in which to break dormancy. More research needs to be done to unlock their secrets. It is possible that they need a period of stratification, or require the presence of certain microorganisms in the soil.

I find that a combination of soaking seeds in water and scarification is the most effective treatment for the majority of native Hawaiian seeds. If you have an abundance of large seeds with thin, hard seed coats to treat, for example legumes like *Erythrina* or *Mezoneuron*, water soaking is easier and less time-consuming then scarifying each individual seed. For small numbers of large seeds, scarification works best, and results in a more uniform germination in a shorter period of time.



Soaking seeds — KLR

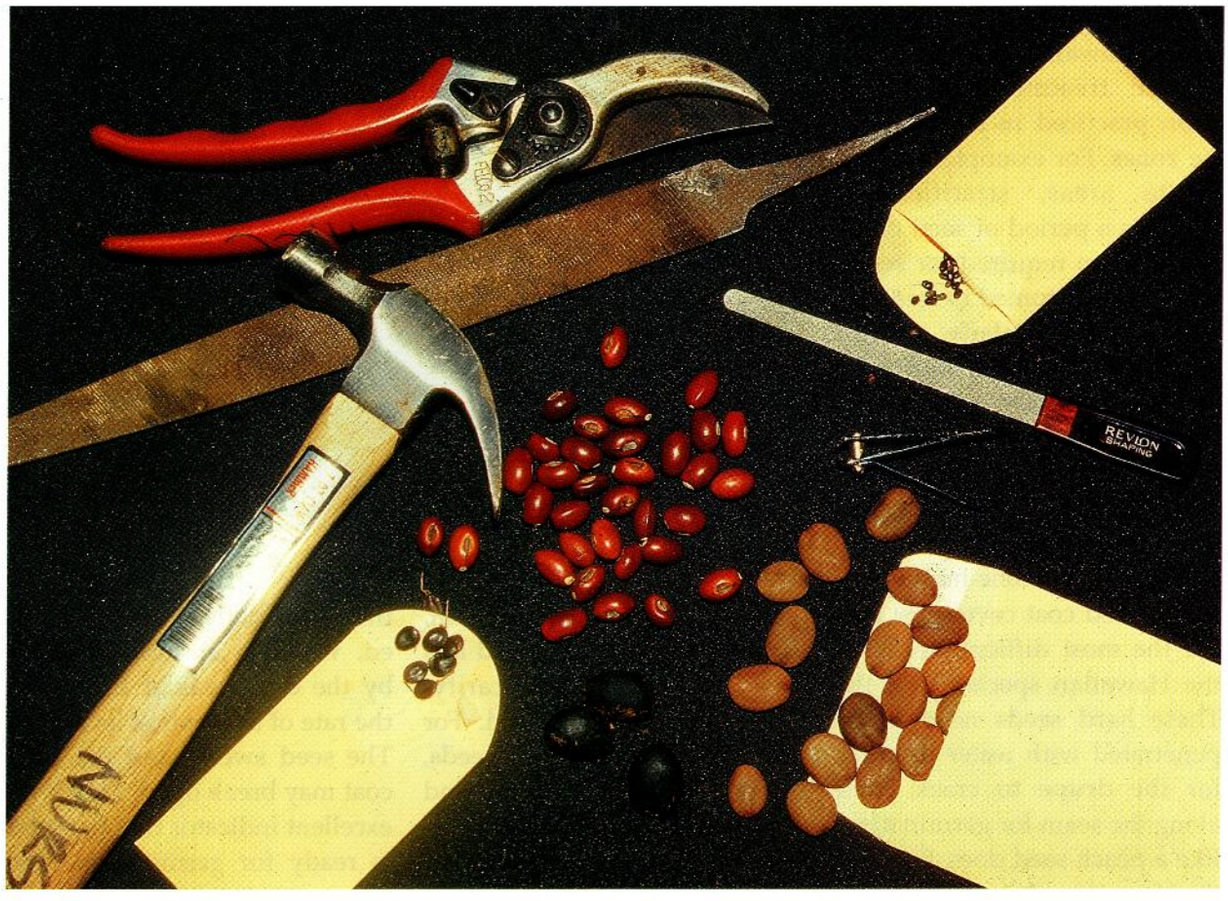
NOTE: Do not scarify a seed before soaking it in water.

When a seed is scarified and then soaked, it will quickly take up too much water, and the embryo will drown and rot instead of germinate. It is better to water soak to soften the hard seed coat first, and then scarify the seed. This will ensure a faster and more uniform germination.

WATER SOAKING

Water soaking is used to leach out any germination inhibitors in the hard, thick seed coats and to reduce the germination time. It is best to use twice as much water as there are seeds; the thicker the seed coat the longer the soaking time. Change the water daily or when needed. Water is absorbed rapidly by the dry seeds at first, then the rate of absorption levels off. The seed swells, and the seed coat may break open. This is an excellent indicator that the seed is ready for germination, and the water soaking should end promptly. Be careful that excess water does not become trapped between the cotyledons (seed leaves), which can suffocate the embryo. Take out the swollen seeds and continue soaking the remaining seeds until they undergo a similar change. Each genus has specific soaking times and treatments within the family profiles.

Hand-hot or tap water: Hand-hot or tap water can be used. Hot water at 120–135°F (50–57°C) is recommended for harder, thicker seed coats. If the water is too hot for your hand, it is too hot for the seed. Cool tap water is fine for most species. At first, some seeds will float; stir them around to dis-



Tools to scarify seeds — DR

lodge any trapped air pockets. After soaking for twelve hours or so, the viable seeds will sink to the bottom, while the non-viable seeds tend to float. If a seed floats, the embryo is probably dead, and there may be air pockets where the live embryo should be. Discard the non-viable seeds by pouring them out. Remember that not all seeds will sink. Some are meant to float; that is how many of them originally arrived in the Hawaiian Islands.

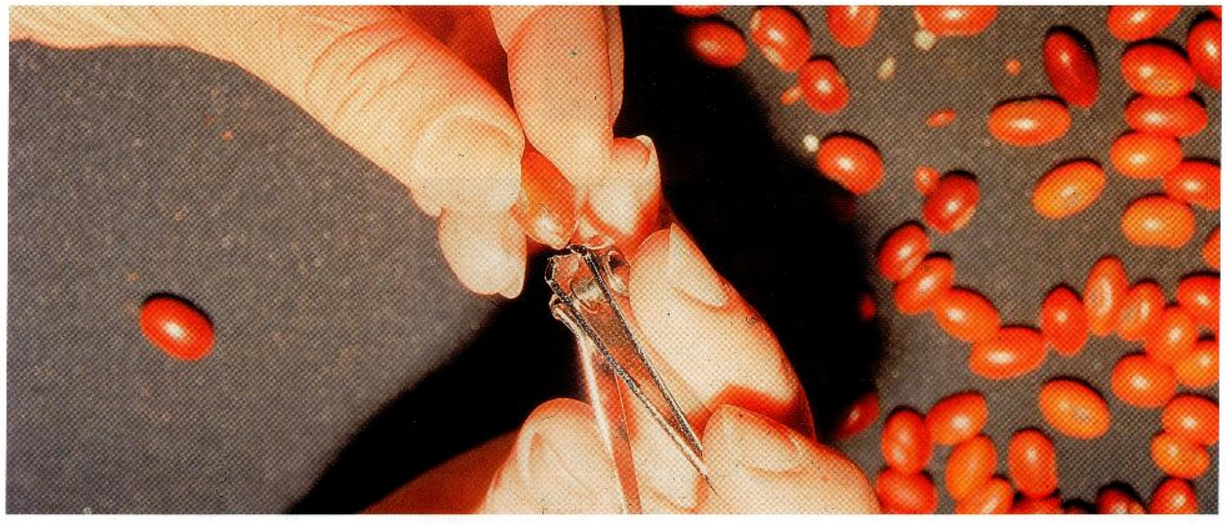
Soaking times: Soaking times vary from a few minutes to a few days, depending on the seed type. Place the viable, pre-treated seeds on a paper towel to dry for storage, or sow right away.

SCARIFICATION

Scarification is the method of creating a crack or opening in the seed coat to allow the absorption of water and gases for germination. A few examples of nature's scarification methods include cracks created in hard, thick seed coats by rolling over rocks in streambeds, microorganism activity in the soil, or passage through an animal's digestive tract. Water soaking does not work for all types of seeds; in some cases seed coats are so thick and tough that the absorption of water or oxygen is prevented, and they are dormant. The dormancy in such seeds may sometimes be broken artificially by scarification. Some examples are *Canavalia*, *Acacia koa*, *Erythrina*, and *Caesalpinia*.

If you are working with small numbers of large seeds, any of these methods is effective:

- Rub a small area of the seed coat with sandpaper or a file to expose the embryo;
- Nick the seed coat with clippers, pruners, or hand shears to create a hole in the hard seed coat, avoiding the embryo (this is my preferred method);
- Gently crack the seed coat with a small hammer along the seam of the seed making sure not to smash the seed.



Scarifying wiliwili seeds—DR



'Ōhi'a seed capsules and seeds (no pretreatments)—KLR

If you are working with large numbers of seeds with hard seed coats, this method is effective:

- Use a stone polisher, tumbler, or concrete mixer with fine cinder or sand of a different size than the seeds to promote adequate scarification;
- Check the seeds periodically to ensure that the inner parts of the seed are not overexposed, which can damage the delicate embryos;
- If you leave the seeds in the mixer too long, you will remove too much of the seed coat.

ACID SCARIFICATION

Some horticulturalists use acid scarification to break down hard or impermeable seed coats (sandalwood). This treatment was not included in this study and consequently no results were obtained. It did not seem necessary here, and I feel this method is not entirely safe to work with.

NO PRETREATMENT

Very small seeds usually have thin seed coats and very little endosperm, and consequently have no dormancy period and do not require any pretreatment. However, it is important to remove all the fleshy pulp from these seeds and sow them soon after cleaning. These types of seed do not store well. Examples include: *Brighamia*, *Portulaca*, *Cyanea*, *Metrosideros*, and *Lobelia*.

There are many ways to clean, treat, and sow seeds. The methods described here are simple and have proved successful for me. They have been effective in growing all the different seed types from the various distinct habitats in which the native plants evolved. Do what works best for you in your growing environment. The important thing is to enjoy the process of growing native Hawaiian plants.

GERMINATION



***Argyroxiphium sandwicense* sub.sp. *Macrocephalum* – 51 days after sowing—PT**

The majority of native Hawaiian seeds take one to six months for of all the viable seeds to germinate. You will usually have to wait until the seedlings have between two and six true leaves before transplanting. Some seedlings need a little help getting their first leaves out of the seed coats. A few examples are *Mezoneuron*, *Erythrina*, *Santalum*, *Tetraplasandra*, *Kokia*, and *Diospyros*, which need to be monitored closely. If within two to three days after they germinate their seed coats are still attached to the cotyledons, you may need to help by carefully and slowly peeling off the seed coat. When only a few of the seeds have sprouted out of a flat, transplant them and keep the flat intact for two more months. Others may germinate later; this is usually the case. Even some pretreated seeds will take up to a year to sprout. If you can, keep seed flats for a full year, which gives all of the seeds the opportunity to sprout.

You have collected mature, ripe seeds, and cleaned and pretreated them to hasten germination. Now it is time for the fun part: growing the seeds! It is always best to start your seeds in the spring and summer months, with longer days and more sunlight. I have observed that some species of seeds will wait until spring to germinate, even though they were sown in the late fall.

The process of seed germination involves four factors:

- Moisture absorption (affects both germination percentage and the rate);
- Favorable soil temperatures (required to change stored foods into usable sugars);
- Oxygen (stimulates the embryo cells to grow);
- Light (promotes germination in most species and affects soil temperatures).
- Adding a small amount of healthy native soil that they were growing in, to the sterile mix, for mycorrhizal fungi dependent plants. I feel most rare native plants difficult to grow in cultivation have a MF dependence (orchids, pūkiawe and olonā).

The growing embryo then swells, splitting the seed coat as it germinates

SEED POTTING MIXES

A good germination mix should supply seeds with the proper moisture, soil temperature, and oxygen. Most importantly, the mix should allow for excellent drainage and aeration. This reduces surface crusting caused by algae growth and discourages damping-off (for example, if fungi are allowed to spread, it can cause seedling death). The mix should also have a neutral pH (6.5–7.0) and be free of any weed seeds, insects, herbicides, pesticides, or diseases. Try to buy potting mixes especially made for growing seeds; avoid mixes with compost, shredded bark, sawdust, or wood shavings that may not be fully decomposed and could

contain resins or tannins; these materials can be toxic to immature seedlings. Buying non-soil mixes that are pasteurized with steam will help control some of these problems. These mixes are made up of sphagnum peat moss (55 percent – 65 percent), perlite, dolomite limestone as a pH adjustment, and gypsum, a wetting agent. Initial seed germination will occur without any immediate nutrition, since the seed lives off stored foods in the seed endosperm. Even when I had this basic knowledge about potting mixes, I still did not know the best mix to use for growing native Hawaiian plants from all of the different plant communities. The soils and environments are so different from those on the mainland, were these mixes are made. I set up experiments with different mixtures, watering times, and recorded the results. One thing is certain: native plants are very sensitive to poor soil drainage. This unquestionably causes damping-off and/or surface crusting. This can be easily solved, either by adding extra perlite or clean-rinsed cinder to the mix to promote drainage, or by reducing the frequency of watering.

RECOMMENDED SEED MIX

Combinations of materials give better aeration and results than a single mix used alone. No fertilizer should be added to the media for seed mixtures. Sunshine Mix No. 4® is my preferred potting mix. These mixes can be used:

- 2 or 3 parts perlite to 1 part potting mix (3:1);
- 2 or 3 parts perlite to 1 part coarse vermiculite (3:1) (good for beach plants);
- 2 or 3 parts small rinsed cinders to 1 part potting mix (3:1).

Your decision about whether to add more perlite to the potting mix will depend on the amount of moisture in the air. The wetter the environment, the more perlite or cinder should be added to the mix. This is important for areas with timed mist systems. For drier environments, you need more potting mix or vermiculite to retain more moisture. Do not mix vermiculite and potting mix together; they both hold water and will pack together in a flat, reducing the airflow through the mix and causing damping-off problems. Uniform moisture to the upper layers of the potting mix is essential, yet excessive moisture will cause diseases. An excellent solution is to place the seed flats on a controlled mist bench with a timer. For those of us who do not have access to mist benches, watering every other day with a misting nozzle attached to a watering can or garden hose is sufficient.

CONTAINERS

Flats — shallow plastic, wooden, or metal trays 3–4 inches deep — are used for germinating seeds or rooting cuttings. I like to recycle containers that we normally throw away, like tofu or mushroom trays or foil cake pans. They are the perfect size and depth for seedlings; all you need to do to these everyday containers is add the proper drainage holes. Make sure that the drainage holes are made from the inside out, and that your containers are cleaned thoroughly to avoid contamination. Fill your shallow container to ¼ inch from the brim with a well-drained mix; pat down the corners and edges evenly.

SOWING SEEDS

Planting the seed at the proper depth is a critical factor. If the seed is planted too shallow, the seed may dry out too quickly. If the seed is planted too deep, seedling emergence will be delayed. The size and the kind of seed being sown determines the proper depth. Keep the mix moist, but on the dry side, and water after sowing the seeds as this helps them settle to the right depth in the mix, according to their weight.

a. Tiny seeds may be too small to break through a layer of germinating mix. Surface sowing on a well-drained potting mix easily solves this. In a dry mix, the seeds sink into the mix better. Use a fine mist to water the seeds in, so as not to blow the tiny seeds away. They will settle into the mix to the proper depth for their germination. Examples are: *Metrosideros*, *Portulaca*, and *Cyanea*.

b. Medium-sized seeds should be covered lightly with mix; the depth should be about the same as the diameter of the

seed. The seed should not be visible after watering; if it can be seen, add a little more mix and water again. Examples include: *Melicope*, *Sophora*, *Wikstroemia*, and *Osteomeles*.

c. Large seeds that are fast-germinating may be planted in individual pots, at a depth that is two to three times their diameter. Most large seeds are fast-growing trees with long taproots. In this case use a deeper pot (e.g., a taproot pot) so the root has room to grow down. Germination is fast (about one week), especially after being pretreated. Examples are: *Erythrina*, *Canavalia*, and *Caesalpinia*.

WATER REGIMES

Aim for a constant, moderate degree of moisture during germination. The mix should not dry out or be soggy, both of which contribute to seedling death. Watering in the morning is recommended, ensuring that the mix will not be too moist during the night, as this can invite diseases. Any intermittent mist systems should be turned off at night, and turned on only during daylight hours, roughly between 6 AM to 6 PM.

Water every other day unless your growing environment is very dry (such as Kaho'olawe), in which case, water every day. Keep the seed containers up off the ground away from slugs, toads, and/or soil-borne diseases. Also, keep them under a covered, shaded area, protected from heavy rains, wind, and direct sunlight, which can be excessively hot and drying, until the seeds have germinated. Once they germinate, start to furnish additional light. For those that do not have access to a nursery, starting your seedlings under a shady tree is fine, but keep the falling leaves out of the seed containers, as they can cause problems with damping-off and can hide slugs, which love to eat seedlings. Slugs are capable of eating an entire plant or flat of seedlings in one night; use bait to control the slugs.

SEEDLING CARE

Germination can vary from one week to two to three years, depending on the species, but for most seeds, one to three months is normal. Be patient, as growing these rare gems is not the same as growing vegetables. The first leaves which appear on many dicot seedlings are two seed leaves or dicotyledons, often bearing little to no resemblance to the later leaves, known as true leaves. For monocots, such as grasses, palms, and lilies, the monocotyledon, appearing as the seed itself is attached to the new seedling, emerges as the first true leaf. All seedlings after germination need light to develop into strong, healthy plants. In dim light, they will grow elongated, with weak, spindly stems. Seedlings also need good air circulation, so avoid locations that are too closed-in, and do not overcrowd the plants on the benches. Monitor seedling stems carefully for signs of damping-off: the base of the stem will turn brown and collapse even though the leaves still look healthy. Damping-off is encouraged by soil that is too wet and poor ventilation. Reduce watering; a fungicidal drench may also help. Seedlings whose leaves droop and shrivel or whose stems bend over are probably too dry. In this case, water the flat thoroughly.

Feed seedlings before transplanting. When watering your seedling flats, simply use a weak liquid fertilizer solution (¼ tsp. to 1 gallon water). Your seedlings should be kept healthy, and have a strong green color until transplantation into their own pots. For some seedlings, such as those from tiny seeds, the time from germination to transplanting can be as long as six months or more. Examples include: *Metrosideros* and *Brighamia*.

TRANSPLANTING AND MEDIA

Transplanting

- For the best result, wait until the dicot seedling has two to four true leaves and monocot seedlings are 2 inches tall.
- If dry, water seedling flats one hour before transplanting. This reduces transplant shock.
- Half-fill pots with slightly moist soil mix.
- Gently remove seedlings from flat. Only handle the seedling by the leaves, or the soil ball around the roots. Do not handle the stem, which is very delicate and easily injured. Use your hand or finger to loosen and lift them from the flat; carefully pull them apart, trying not to

disturb the small ball of roots and clinging mix.

- Place the root ball into the half-filled pot, then add the remaining soil, and cover the roots only to the base of the stem, not up to the leaves.
- Thoroughly water pots with a fine spray nozzle. Straighten out any seedlings lying down after watering.
- Label the pots with the plant name, date started, transplanted, etc.
- Keep them moist and out of direct sunlight for a week or so, then gradually move them from filtered sun to full sun in a couple of weeks, depending on the individual plant's needs.

Transplant mixes: A totally sterile mix is not necessary at this point; use some of the soil the plants will be living in.

Heavy soils, such as clay
2 to 3 parts perlite or cinder
1 part clay soil
1 part bagged potting mix

Medium soils, such as organic forest litter
3 parts perlite or cinder
1 part soil
1 part bagged potting mix.

Light soils, sandy loams
1 part bagged potting mix
1 part sandy soil
2 parts perlite or cinder (if sand is fine-textured)

Volcanic soils
1 part bagged potting mix
2 to 3 parts volcanic soil (cinder)

Compost soils
2 to 3 parts perlite or 2 parts cinder
1 part well-decayed compost soil
1 part bagged potting mix

The soil mixture you choose to make should depend on the location and environment the plants will be growing in. The wetter it is, the more drainage your mix will need.



***Hibiscus clayi* seedlings – NTBG nursery — KLR**



Potted seedlings of *Brighamia insignis* – NTBG nursery — DR

NUTRITION AND FERTILIZERS

I have found that native plants are sensitive to strong fertilizers, and that half the recommended dosage is sufficient. Add the fertilizer when mixing the soil; do not add it on top of the mix.

I recommend using an organic, slow-release fertilizer of 8-8-8 NPK and micronutrients (minor elements), not present in sterile potting mixes and lacking in some of the depleted Hawaiian soils. These fertilizers provide nutrients to the plants gradually over a long period of time and reduce the possibility of fertilizer burn. Between once a month and once every three months, foliage-feed your potted plants with a liquid fertilizer (following directions on the label). The nozzle feeder works well for this.

ASEXUAL (CLONAL) PROPAGATION



Unrooted to rooted *Hibiscus brackenridgei* cuttings — KLR

CUTTINGS

Propagation of cuttings, the most widely used method of propagation, is a method of genetic cloning or asexual reproduction of the parent plant. Cuttings are taken from the vegetative portions of the plant: the leaves, stems, roots, and modified stems (tubers, rhizomes, corms, and bulbs).

The condition of the parent plant supplying the cuttings is very important. Generally speaking, the more vigorous and healthy the parent is, the better the cuttings will root and grow. My goal when starting cuttings is a 100 percent success rate. These are the steps I take to achieve this goal.

It is important to have clean, sharp tools for taking the cuttings. A sharp cut at the basal end ensures less damage to the cells that will be forming the roots, and clean tools help to prevent the spread of plant pathogens from plant to plant. If for some reason the cuttings cannot be started right away, keep them in a sealed plastic bag in the refrigerator no longer then a day or two. This helps keep them moist and turgid with an abundance of stored foods for rooting. The longer you wait to start the cutting the lower your rooting percentage will be.

For maximum results take cuttings in the cool morning hours to ensure the cuttings have a high level of stored foods (carbohydrates) to nourish the developing roots and leaves until the new plant becomes rooted and self-sustaining. The stored foods are carried from the top of the plant to the roots during the heat of the day. To regulate the plant's water levels, the plant transpires by using

stomata, which are tiny pores opening in the epidermis (surface) of the leaves, which control moisture and gas exchange. Avoid collecting cuttings from plants that are infested with insects or are diseased or drought stressed. If drought is a problem, water the plant for a week before taking the cuttings to ensure a higher level of stored foods for growing healthier roots.

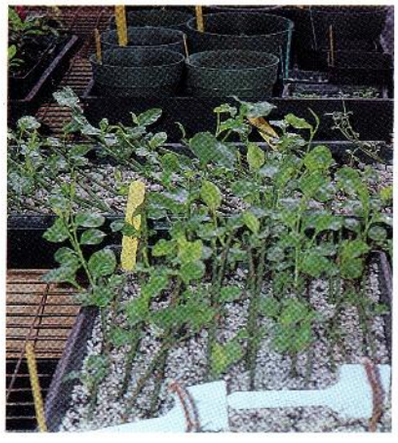
Stem cuttings are divided into four different types, depending on the stem maturity, the time of year the cuttings are taken, and the plant type. For Hawai'i, the best season to collect cuttings is from early spring to mid-summer. The four types of cuttings are hardwood, semi-hardwood, softwood, and herbaceous.

Hardwood

- Hardwood cuttings are made from the mature wood of last year's growth from hardwood trees and shrubs. Cut brown woody stems of moderate size from the central or basal shoots (not from weak growing interior shoots).
- The cuttings should be 1–4 inches in diameter, and 5–12 inches long with at least three nodes. The top cut should be ¼–1 inch above a node at a right angle; the basal (base) cut is made just below a node at a slant, exposing more rooting cells; the cutting size depends on the type of plant. Longer and thicker cuttings take longer to root, and are harder to handle when they are potted up.
- At the time the hardwood cuttings are taken, remove all of the leaves, ensuring that the cuttings will retain more moisture and will root faster. If you choose to leave some foliage on, reduce it by cutting the foliage in half.
- Remove all of the green tips from these cuttings to where the woody portion starts, as hardwood tip cuttings are lower in stored foods and root poorly. Also remove all the leaves remaining and any small side shoots since these leaves and shoots allow essential stored moisture to escape, take up more room in the rooting flat, and leaves would probably fall off eventually into the rooting mix increasing the likelihood of disease.
- Start your collection of cuttings as soon as possible into a sterile cutting mix. It is important not to let the cuttings dry out or be exposed to the full sun at any time prior to rooting. Keep the cuttings in a clean, sealed plastic bag, wrapped with damp clean newspaper or sphagnum moss — anything that will keep them moist during transport. If you can, put the bag of cuttings in a cool ice chest with an ice pack during transport to the growing area, but make sure not to keep loose cuttings on loose ice cubes in the chest as this will damage them.
- To prepare cuttings for rooting: just before starting, re-cut the base at a 45-degree angle, exposing fresh cells, then dip the freshly cut surface into the appropriate rooting powder. Insert the cuttings 3–4 inches apart into the rooting mix with at least one or two nodes under the mix. Make sure that the larger cuttings are securely held in place during rooting but are not planted so deep that the base of the cutting does not receive proper aeration (airflow), a requirement of healthy rooting.

Semi-hardwood

- Semi-hardwood cuttings are those taken from trees and shrubs in the summer months from the new shoots, just after the flush of spring growth, when the wood is partially mature. Make the cuttings 3–7 inches long, with at least three nodes. Remove only the lower foliage and retain three or four new leaves on the top. Remove any bug-infested leaves to stop further damage. Semi-hardwood cuttings are more prone to drying out. To avoid this, follow the directions above for keeping cuttings moist during transport.
- If the top leaves are more then 2 inches long, reduce the leaves in size by cutting them in half. This lowers the water loss and allows for closer spacing in the cutting flat.
- Just before starting: re-cut the base at a 45-degree angle, then apply rooting powder. Place cuttings 2–3 inches apart, with one node inserted into the rooting mix.
- Cuttings should be rooted under conditions that will



***Plumbago* cuttings – NTBG nursery — KLR**



***Herbaceous* cuttings — KLR**



***Nephrolepis cordifolia* – tubers and rhizomes — KLR**

minimize water loss from the leaves. Root under an intermittent mist system or in a covered cool moist place, off the ground, and out of the direct sun. Placing the pot of cuttings in a sealed plastic bag works well in drier locations to keep them moist, but be careful not to keep it too wet or the cuttings may rot.

Softwood

- Softwood cuttings are taken from small shrubs and groundcovers whose stems are soft and succulent, or from the plant's new spring growth. Softwood cuttings should be 3–6 inches long with at least two or three nodes. Again, remove only the lower foliage and retain the top leaves. Cut the leaf in half if it is more then 2 inches long. Place cuttings 2 inches apart in shallow rooting flats, with at least one node inserted into the well-drained rooting mix.
- These cuttings generally root more quickly and easily than any other type, but they require more constant attention to keep them from drying out completely at any time during rooting. If at all possible, place them under a controlled mist system for rooting, or in a covered, cool, moist, shaded place, away from the direct sun. Water them daily in the morning, or if they are in drier locations, place the pot of cuttings within a sealed plastic bag, out of direct sun.

Herbaceous

- Herbaceous cuttings are from succulent plants that usually do not develop woody stems and stay succulent through out the year. Follow the directions for starting softwood cuttings.
- Again, drying out is the biggest problem associated with rooting these cuttings, unless they are from very dry areas like *Portulaca molokiniensis* from Molokini Islet or *Euphorbia haeleeleana*, which has milky latex in all its plant parts. These will need to dry out slightly for a few days to a week, similar to cactus or plumeria cuttings' need to callus before planting to avoid rotting.

Tubers or rhizomes

- The tuberous or rhizomatous stem of the native begonia (*Hillebrandia*) and some ferns can be divided after new growth starts in the spring. Make sure that every 3–5-inch section has at least one bud for new growth. Gently dig under the plant until you find the tuberous or rhizomatous root system; cut a section with buds 3–5 inches long. Keep these cuttings moist and in a plastic bag until planted into 2–3 parts black cinder or perlite to 1 part potting mix (3:1). Keep cuttings cool, moist, and out of direct sun.



Rooting hormones—KLR

Rooting hormones: Rooting hormones are synthetic, root-promoting chemicals that stimulate root growth. The purpose of treating the basal ends of cuttings with hormones is to increase the rooting percentage and hasten rooting time. Both the powder and liquid forms are satisfactory. I prefer rooting powders as they are easier to work with, but be sure to carefully follow the directions on the label. Powder hormones with added fungicides are especially useful for wetter growing conditions. More details will be provided on specific hormones within the genus profiles.

- Hardwood cuttings use rooting powder Nos. 8–30 and up.
- Semi-hardwood cuttings use Nos. 3–8.
- Softwood cuttings use Nos. 1–3.
- For herbaceous cuttings, use No. 1 with fungicide or no rooting powders at all. They still root easily enough without added stimulants.

Cutting mix: The cutting mix has three functions:

- To hold or support the cutting in place during the rooting period;
- To permit proper aeration to the base of the cutting;
- To provide adequate moisture to the cutting.

There is no one ideal rooting medium. Instead, there are several different combinations of materials that will make a good workable mix that provides sufficient porosity to allow good aeration and has a high water-holding capacity that nevertheless drains well and is free from harmful diseases and weed seeds. The requirements are the same for germinating seeds.

Recommended cutting mixes

- 2–3 parts perlite to 1 part vermiculite
- 2–3 parts perlite to 1 part potting mix or 1 part coarse vermiculite
- 2–3 parts rinsed clean fine cinder to 1 part potting mix
- 100 percent rinsed-clean fine cinder will work, but it can dry out faster. It is, however, a good mix for use under an intermittent-mist system.
- Oasis cubes work well, but can be expensive.
- A good basic mix uses a pasteurized, soil-less mix, to ensure that there are no weed seeds, pesticides, insects, or diseases to disrupt rooting. Avoid mixes with untreated ground pine bark, sawdust, or sand added; these mixes are not pasteurized, and diseases might be present. I do not suggest combining potting mix with vermiculite, because they both hold water and eventually restrict the proper airflow, which may rot the cuttings (unless you are in a very dry location with limited water). My preferred mix is Sunshine Mix No. 4®.

Containers and watering

- Smaller cuttings should be in shallow flats 3–6 inches deep, with drainage holes. These containers need to be deep enough to insert at least one node at the base of the cutting below the mix surface and hold the cutting firmly in place without movement during rooting.
- For larger cuttings a 3-gallon pot, half filled with rooting mix, works well.

Watering cuttings

- Chlorinated tap water is preferable to lake or stream water, since tap water contains fewer living disease organisms, salts, or algae. These can accumulate in the cutting mix and reduce or even prevent rooting. Rainwater is best, if it is pure.
- The cutting mix should be leveled and watered thoroughly with a fine spray nozzle before the cuttings are inserted. Afterwards, water lightly to settle the mix around the cuttings enough to help hold them in place, but not enough to wash away the rooting powder you have just applied to the base. For the cuttings that have foliage remaining and are not under a mist system, several light sprinklings with a fine mist of water each day is better than a heavy soaking less frequently. Never allow the mix to stay

excessively wet or to dry out completely during rooting.

- Cuttings will root with the proper moisture and hormone treatment anywhere from two weeks to six months after planting, sometimes longer, depending on the species and the time of the year the cuttings were taken. Rooting times will be specified within the family and genus profiles.

The care of cuttings during rooting

- Cuttings must be placed in a covered, shaded area, out of the direct sun and strong winds.
- Remove all dropped leaves and sprouted weeds immediately from the flats, along with any obviously dead cuttings. This helps to prevent the spread of disease.
- If mites, aphids, or mealy bugs appear on the cuttings, control promptly. They can be rubbed off by hand or, for large numbers of cuttings, sprayed with a mild insecticidal soap.
- After your cuttings start to grow new foliage, fertilize them monthly with a foliar feeding fertilizer. Miracle Gro® works well, and is easy to use with a nozzle applicator.

Transplanting rooted cuttings

- A good indicator that the cuttings are rooted is a flush of new growth. When gently tugged, they should give resistance. Carefully dig under a cutting to check for a sizable root system. If you are patient and wait until they are well rooted, with a small, fibrous root ball, before transplanting them from the rooting mix, you will have a higher survival rate. Transplant during the cool morning hours. Rainy days are also good, or in shady conditions. However, do not expose new delicate roots to direct sun, or allow them to dry out during potting.
- Choose a pot a little larger then the root ball; half-fill the pot with a well-drained soil (the same as for seedlings). Carefully and gently loosen the mix around the cuttings by moving your hand under the mix and root ball; do not pull or tug the cutting out, as this may damage the roots. Place the cutting in the pot, then cover the roots with remaining soil, and gently tap down to stabilize the cutting.
- Water thoroughly. It is critical that the water drains freely, and does not sit on top of the soil mix. Keep the newly potted cuttings in a shaded area out of the wind for two to three weeks, and then move them into more sun to harden them off and prepare them for outplanting in six to twelve months, depending on the plant.

Transplant mixes

At this point, a totally pasteurized, sterile mix is not necessary. It is more important that the mix is well-drained, to encourage healthy growth.

Heavy soils, such as clay
3 parts perlite or cinder
1 part soil
1 part bagged potting mix

Medium soils, such as organic forest litter
2–3 parts perlite or cinder
1 part soil
1 part bagged potting mix

Light soils, sandy loams
2–3 parts perlite or cinder
1 part bagged potting mix
1 part light soil

Volcanic cinder soils
1 part bagged potting mix
1 part volcanic cinder

Compost soil
3 parts perlite or cinder
1 part compost soil
1 part bagged potting mix

- The soil mixture you choose should depend on the location and the environment the plants will be growing in. The wetter the environment, the more drainage the mix will need.
- Soil drainage can be easily increased by amending the soil with perlite, medium cinder, or pumice. To help the soil hold more moisture, use potting mixes with peat moss, shredded sphagnum moss, and vermiculite.

Nutrition and Fertilizers

- Native plants are very sensitive to strong fertilizers (14-14-14 and higher). Applications using half of the recommended dosage is sufficient. In this case, more is not always better; if you have any doubt use less.

- I prefer to use an organic, slow-release fertilizer. These fertilizers provide nutrients to the plants gradually over a longer period, and help reduce the possibility of injury from excessive application. I recommend 8-8-8 NPK fertilizer, and micronutrients (minor elements) not present in sterile potting mixes and lacking in some of the depleted soils of Hawai'i. Add the fertilizer and micronutrients when mixing the soil, not on the surface afterwards.
- Once a month, foliage feed your plants. A liquid fertilizer, using the nozzle applicator, is easy and it works well.

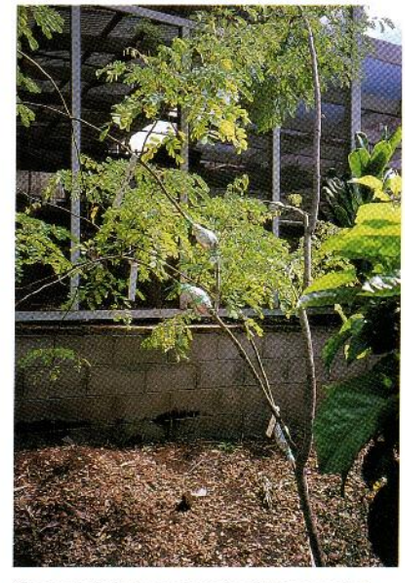


***Kokia cookei* air layer at Waimea Arboretum, O'ahu – Winston and Kerin — MC**

AIR LAYERING

Air layering is a form of asexual propagation by which a branch on a tree or shrub is made to root while still attached to the parent plant. This is one of my favorite methods of plant propagation. Air layering is used on plants that are not easily propagated from seeds or cuttings, or when a larger plant is desired in a shorter period of time. It is commonly used on tropical fruit trees such as lychee. Some native plants are so endangered that as a conservation measure, we air layer the large branches that need pruning instead of pruning and throwing them away. The great advantage to air layering is that your rooted air layer will act the same age as the parent plant it is taken from and will flower and fruit far sooner than a seedling or cutting. Of the native plants I have air layered, such as *Hibiscus*, *Metrosideros*, *Xylosma*, and *Caesalpinia*, all have rooted readily within three months. My experience suggests that most native Hawaiian plants are good candidates for air layering. However, more research needs to be conducted on air layering other native plants before this subject is clearly understood.

When air layering, it is always best to choose healthy, vigorous growing trees or shrubs that are in the ground, as opposed to containers. You may have more control over the progress and final results if you have the opportunity to use parent plants that are on private property. They can be monitored from time to time, whereas in the wild there is no guarantee that your air layers will still be there when you return in three months' time. On state or federal land, you will need to obtain the proper permits. Private property, of course, also requires permission from the owner. For unknown reasons, all of the air layers I started in the wild for NTBG were cut off and taken by other people before they could root properly.



***Caesalpinia kavaiensis* air layered at NTBG nursery — KLR**

In Hawai'i, air layering can be done at any time of the year as long as the bark of the plant is easily removed. The optimum time of year for this is the early spring months (March, April, May) just before the new growth begins. Roots will develop in two to six months.

- Select a well-shaped, woody branch of the previous year's growth 1–6 inches in diameter. Remove any branches in your way to give your hands plenty of room to move around. Larger branches can be air layered, but rooting is less satisfactory and the resulting roots are usually not strong enough to hold up the larger plants.
- With a clean, sharp knife make a girdle around the branch, making sure you go deep enough to completely remove a stripe of bark from the branch ½ to 1½ inches wide depending on size of the branch; if the bark does not slip (peel off), the plant is not in the proper phase of growth for air layering. There is no point in continuing unless the bark peels off freely.
- Scrape the newly exposed, light-colored woody surface to ensure the complete removal of the cambium (cells that form new tissues). If the cambium layer is not removed, callus will grow over the girdled area, preventing root development.
- Apply rooting powder to the top of the girdled area. When air layering a species for the first time, I use different hormone strengths to test which ones root the best. More specific hormone strengths will be discussed for each plant within the family and genus profiles.
- Place about two handfuls of slightly damp sphagnum moss with all of the excess moisture squeezed out around the stem, enclosing the area that is girdled and covered with hormone; if the sphagnum moss is too moist, the girdled area will rot.
- Wrap a piece of plastic wrap, 8–10 inches square, completely around the moss. Tie both ends securely with a waterproof material such as electrical or half-inch green garden tape, particularly the upper end, to prevent any additional moisture from entering during heavy rains.
- Then wrap aluminum foil 8–10 inches square, dull side up, around the entire air layer, tightly tying both ends. This provides darkness for the newly forming roots and creates a more uniform root ball, as the roots tend to avoid the sun. It also helps protect the plastic wrap from the elements.
- Remember to always keep records of the rooting powder used, the date the air layer was made, etc., so you will know what works or does not work. Rooting takes two to six months, depending on the kind of plant, what time of year you air layered, and the plant's overall health.
- It is important to monitor your air layers. Ants, birds, and bad weather can rip holes in the aluminum and plastic wrap causing the moss to dry out. If this happens earlier on, remoisten the moss and reapply new plastic wrap. If the stem and roots were left exposed too long, they will dry out and die, and may not be recoverable.
- In two to six months, unwrap the aluminum foil. The roots will be visible through the plastic wrap. Cut off the rooted air layers at the bottom end for transplanting when the moss is fully packed with roots in late summer to early fall.
- Prune off some of the top foliage to prevent the plant from being top-heavy and moving around in the pot. If too much foliage is left on the air layer, some of the older foliage will yellow and fall off. This may indicate that the plant is in shock, but it is not dying. It is adjusting to being removed from the mother plant.
- In a shaded area out of the direct sun, carefully remove all the ties, aluminum and plastic wrap, leaving the mossy root ball intact. Also remove any stem left below the root ball.



***Hibiscus brackenridgei* rooted air layers — KLR**

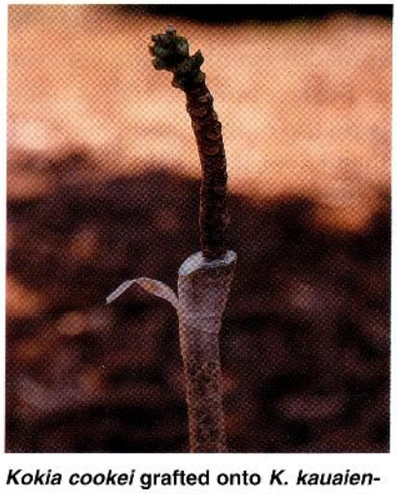
- Transplant into a pot that will accommodate the air layer's size. It is important that the plant does not move around in the pot or it will cause root damage. Again, use a well-drained soil, water every other day, and keep in a shaded area away from strong winds so the roots can take hold and grow into the soil.

- In three to six months, when the roots grow to the bottom of the pot, the air layers are ready for repotting into a larger pot, or outplanting into the ground.

GRAFTING

Grafting involves the insertion of a short portion of stem, called a scion, into another stem with a strong root system, called the stock. The cambium layers (the cells producing new tissue) of the stock and scion must be placed tightly in contact with each other, and all parts being grafted must be related to one another in the same genus, or in some cases, the same family.

Grafting can be very useful for preserving those rare plants that fail to propagate by other, simpler methods. The time, skill, and complications involved in grafting mean that it is not recommended for plants easily propagated by other techniques. Grafting could help preserve species with bottlenecked populations on Hawai'i from being endangered. For example, for species with small individual or population numbers left, regeneration involves limited genetic material which can result in inbreeding. Inbreeding has caused some plants to become genetically weak and lose their ability to reproduce effectively. These weak plants have insufficient amounts of stored nutrients, their seeds are nonviable, and cuttings and air layers fail to root. Since future generations are in such peril, management measures that include grafting can be a good way to save them from extinction.



***Kokia cookei* grafted onto *K. kauaiensis* rootstock – NTBG — KRW**

The grafting of native Hawaiian plants has been explored, but is not yet completely understood. A great deal of work has been done on the Malvaceae (hibiscus family). The rare *Kokia cookei* is a good example. It is a Moloka'i native, now extinct in the wild and surviving only in cultivation. Staff at Waimea Arboretum saved it by grafting it onto the rootstock of *Kokia drynarioides*, an endemic to North Kona, which is also endangered.

In 1998, I received some scion material of the *Kokia cookei* from Waimea Arboretum's mother plant. I used *Kokia drynarioides*, which was grown from seed, for the rootstock. I tried both top and side grafts; the top grafts worked the best. I also grafted the *Gardenia brighamii* from Moloka'i, of which there is one plant left in the wild, onto the same species of the O'ahu gene pool, which is not as threatened and produces many viable seeds.



***Kokia cookei* flower — JD**

Further work is being done at the NTBG on *Hibiscadelphus woodii*, a newer species endemic to Kaua'i, and *Kanaloa kahoolawensis*, a new genus and species from Kaho'olawe discovered by NTBG collectors, for which only one plant is left in the wild. Both of these species have difficulty reproducing themselves, most likely because of their isolation, inbreeding depression, and degraded, harsh environments; these factors stress the plants and result in weak growth. The *Kanaloa* is monotypic, meaning that the genus has only one species. Finding a compatible rootstock is quite challenging. Plants in the same family that closely resemble the *Kanaloa* were all considered. I used the *Pithecellobium dulce* (opiuma), an aggressive introduced coastal plant, as a rootstock, which was grown from seed. To date all of the grafts have failed to callus, and different plants are still being tested as compatible rootstock.

There have been many books written about grafting. I recommend thorough study of the subject and practice on nonnative hibiscus hybrids before any attempt to graft threatened native plants.

PTERIDOPHYTE (FERN) PROPAGATION



***Hāpu'u* tree fern – Kerin's yard—KJ**

Fern spores are found from late spring to early fall on the undersides of fern fronds (fern leaves); many species have small round cases filled with spores called sporangia.



***Cibotium* sp. *Sori*—MC**

COLLECTING SPORES

- Collect spores by picking a frond or piece of one with ripe sori (clusters of sporangia), which are usually either golden, dark brown, or black in color when ripe.
- Place fronds in a clean, dry paper bag or between two sheets of paper. The spores will begin to drop within a day or two.
- Sow spores right away for best results. Remember to label your plants and keep records.

STARTING SPORES

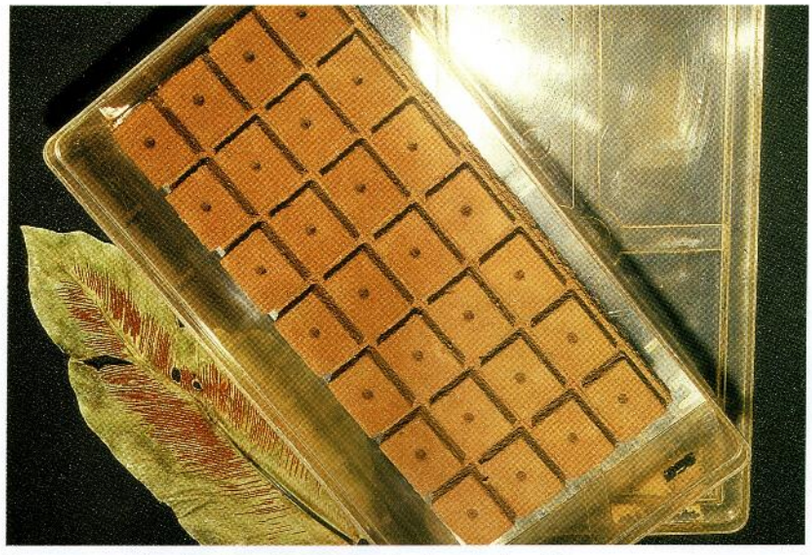
There are many different ways to start spores; this is what worked for me.

- Use a clear, shallow container about the size of a shoebox, with no holes in it and an airtight lid.
- Either use finely graded sphagnum moss, or hāpu'u (from tree ferns) and/or fine black cinder, any of these medias mixed together or by themselves.
- Or you can use oasis cubes or a clean clay brick in the container, with ½ inch of distilled water in the bottom.

Sterilize everything to prevent fungi or algae growth from smothering the prothallia (young ferns). This can be accomplished by placing all of the materials in boiling water for ten minutes or longer.

Once the sphagnum moss (squeezed out), or hāpu'u and/or fine black cinder is cool enough to touch comfortably, spread it evenly in the container. Surface sow the spores lightly on top of the chosen material, then cover it. The lid should be airtight; this may require you to tape the seal if needed. Do not layer the spores densely on top of each other; this will waste spores and also hinder the development of the young ferns.

It is important not to let the moss, hāpu'u, fine black cinder, or brick dry out at any time dur-



Fern propagation (oasis cube and plastic shoe box)—DR



Germinated fern spores—DR

ing the germination period. Moisture is needed to carry out the sexual fertilization procedure, which initiates the growth of the adult ferns. Your container should be airtight; be sure to mist with distilled water if drying out occurs. Temperatures of 70°F (21°C) and above induce the best spore germination. Place the container in a protected, partially shaded area to prevent it from drying out. Be patient. In four to six weeks, depending on the species and the freshness of the spores, a green haze made up of many tiny clumps of prothalli (heart-shaped leaves) will form on the moss surface.

TRANSPLANTING AND MEDIA

When these tiny ferns grow large enough, they are ready to be transferred into a sterile soil mix. The small true leaves, about the size of a pea, will be visible; this may take approximately six months. They are still vulnerable to diseases and drying out at this stage.

Fern transplant mixes

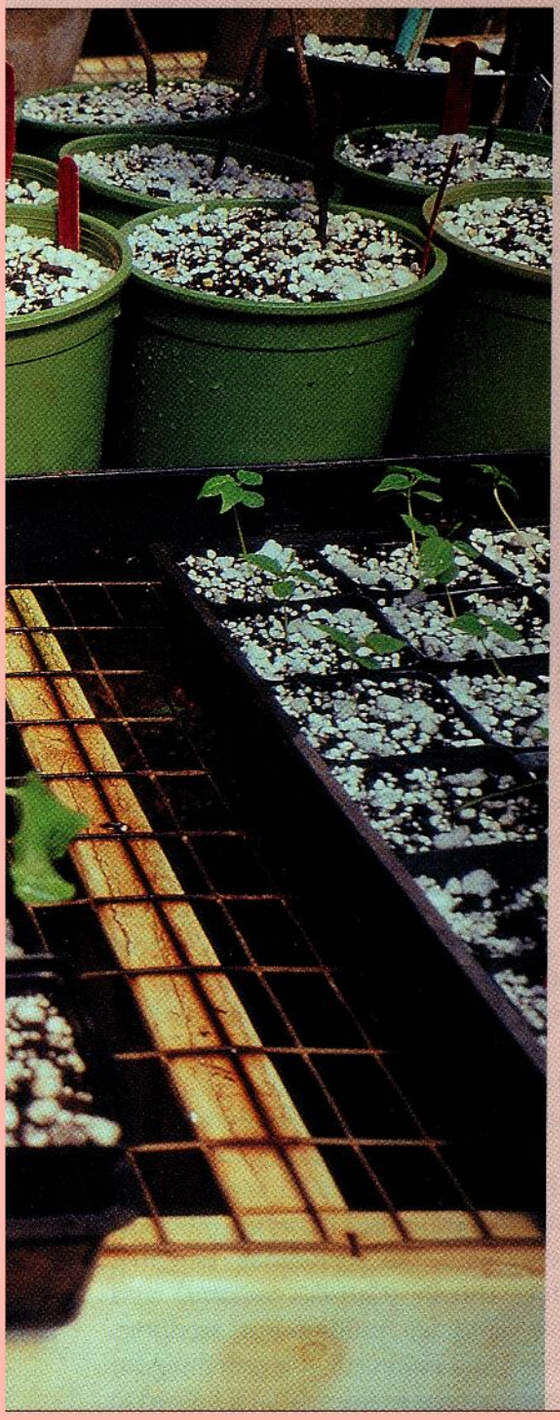
- 1 part potting mix to 2–3 parts perlite (1:3)
- 1 part potting mix to 3 parts fine, rinsed black cinder (1:3)
- Or 100 percent rinsed black cinder (good for plants under a mist system)

Very carefully and gently, without disturbing the roots, remove the small fern clumps, potting them into their own 1–2 inch pots, depending on the plant and root size. Water them in at first. The chlorine in some tap water can be harmful to the ferns at this early stage. Rainwater can be used as a substitute if it is pure. If possible, use distilled water for the first week, water every other day or when they become dry. Use tap water thereafter. For best results, keep the potted ferns under a mist system; if you do not have a mist system, a protected and shady area, off the ground and out of the wind, will also work. Be sure to monitor their growth and conditions often, and do not let the soil mix dry out at any time. Remember, the ferns just came out of a moist environment. Transplant them into 4–6 inch pots when the ferns become root-bound, usually within two to five months. Use the same mix recommended for rooted cuttings and seedlings.



Kokia drynarioides **seedlings for Ka'ūpūlehu outplanting—KLR**

GREENHOUSE



When maintained properly, a greenhouse provides a controlled environment that promotes maximum plant growth and development. There are five basic environmental factors that need to be maintained at the proper level, in order to grow healthy plants. They are:

- Moisture;
- Soil temperature;
- Oxygen;
- Light;
- Nutrients.

Young plants and unrooted cuttings need this added protection from extreme weather conditions, diseases, insects, and hungry animals. It can shield them from such unwelcome visitors as slugs and rodents, which will eat the seeds and the tender seedlings.

GREENHOUSE MANAGEMENT



***Kokia drynarioides* seedlings – NTBG nursery — KLR**

MATERIALS

The glass greenhouses with elaborate heating and cooling systems, commonly used in temperate zones, are not necessary in tropical regions. Regions with mild year-round tropical climates, such as Hawai'i, need only a simple wood or metal-framed structure to provide good ventilation. This helps to control the temperature and humidity. It can also house wire-top benches, an irrigation system, potting mixes, and other materials. If a greenhouse is not available, a bench or table under a shade tree, closely monitored, can also produce fair results.

SHADE

A greenhouse structure should provide three levels of protection and shade.

- 50 percent shaded covered area
- 30 percent shaded open area
- Full-sun area

The propagation area ideally includes a solid, clear, plastic roof that provides about 50 percent shade. It can be used for germinating seeds, rooting cuttings, and caring for sensitive plants that need extra protection. It is also where a mist box or bench, which creates high humidity, would be best housed. This is also the best area for propagating plants from wetter environments, or green softwood, and herbaceous cuttings that need the extra moisture.

To protect the seeds and cuttings from pests, this area should be closed in with secure shade cloth walls. I have had problems with the melodious laughing thrush (*Garrulax canorus*) and rodents pulling out seedlings and cuttings while searching for insects in the media. It helped to

have the entire propagation area enclosed.

Plants ideal for the 30 percent shaded open area include newly transplanted plants such as seedlings, rooted cuttings, air layers, and grafts that all need to be slowly hardened off as they adjust to more sun.

The open area with full sun and no roof or shade cloth is also useful to harden off plants and prepare them for transplanting out-of-doors.

Plants need these different growing conditions at different stages in their lives to help them become healthy and strong enough for outplanting into the ground, the ultimate goal. Native hardwood plants do not do well in pots for long periods of time. In general, I like to outplant them when they have outgrown a 4-inch pot (for ground covers and small shrubs), or a 1-gallon pot (for larger shrubs and trees), depending on the plant.

IRRIGATION

Irrigation is an important factor; overhead misting or hand watering should be done every other day. During the rainy season, water only the covered propagation area. Close monitoring of soil moisture is critical. Remember that overwatering can cause damping-off, which may kill seedlings. If possible, avoid using water from streams or lakes, which has too many contaminates. Rainwater is best, if it is pure.

SANITATION

Sanitation is an essential part of greenhouse management. Good sanitation can reduce or prevent plant diseases and the invasion of insects, pests, and weeds.

PEST AND DISEASE MANAGEMENT

Make sure that all new plant materials are disease and insect free before they come into the propagation area. During germination and rooting periods, use pasteurized soil-less mixes to eliminate weed seeds and pathogen problems. Always use clean containers, flats, or pots; if they are soiled, wash them in a weak bleach solution of 1 part bleach to 10 parts water (1:10). Also disinfect the shears, knives, or any other tools used for propagation. Try to keep young plants elevated off the ground on benches and away from slugs, ants, and soil-borne diseases. The floor of the greenhouse should always be free of plant debris and weeds. Keep pests from crawling up the bench legs, and keep hose nozzles off the ground where they might pick up disease pathogens. This requires a commitment of time, but it is essential and worthwhile for the successful propagation of native Hawaiian plants.



Slug on ʻōhiʻa seedlings — KLR

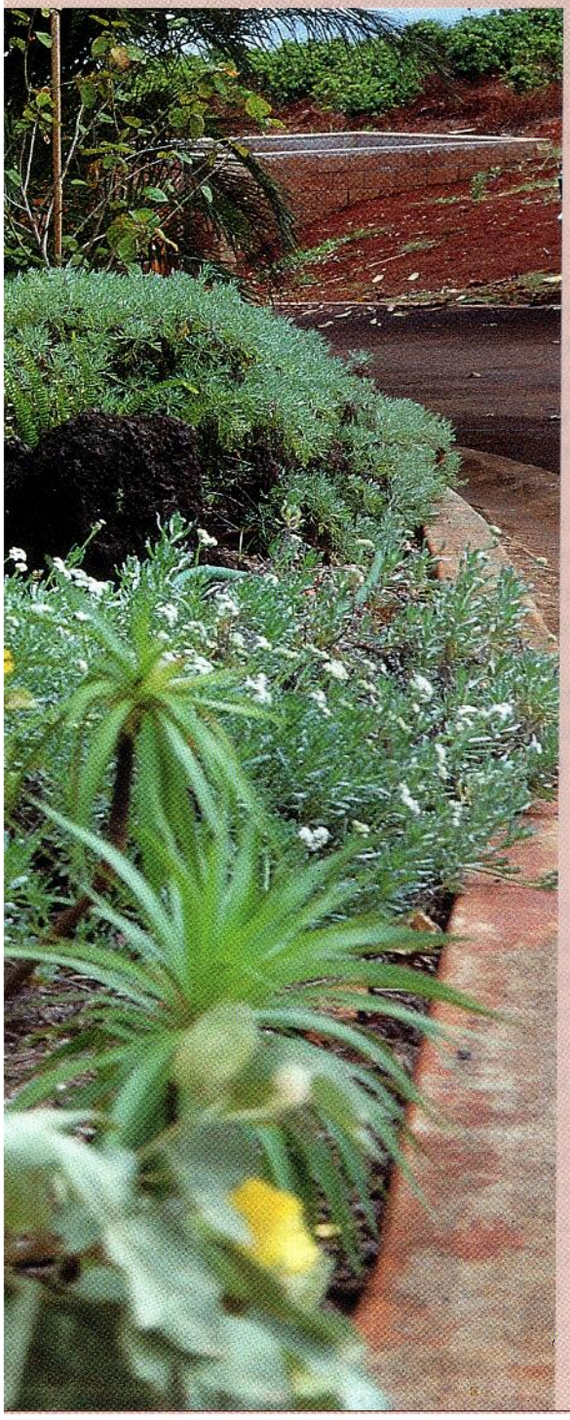
CONTAINER PRODUCTION AND MAINTENANCE

If you prefer to keep your native plants in containers instead of outplanting them, here are some guidelines. Use the same medium that is recommended for transplanting. Transplant your container plants into larger pots every year, replacing the media or just changing the top layer of mix. If you see roots at the top of the media in the pot, this indicates that the plant is rootbound, and your native plant needs to be repotted.



Outplanted native Hawaiian garden – NTBG — CC

Transplanting and Outplanting



Transplanting and outplanting is best done in the rainy season. Your plants will be ready for outplanting or repotting when your seeds, cuttings, and other plant materials are well rooted, growing healthy, or have outgrown their pots. This is indicated when the roots fill the bottom of the pot, but are not root-bound. The roots of root-bound plants circle several times around the bottom of the pot or become visible at the top of the media. Severely root-bound plants are short-lived; the circling roots strangle the trunk of the tree or larger shrub, eventually killing the plant. Outplant ground covers and small shrubs out of 4-inch pots, large shrubs and trees out of 1- or 2-gallon pots, before they become root-bound.



Hibiscus waimeae **root-bound damage—KLR**

TRANSPLANTING AND OUTPLANTING

LOCATION

Give careful thought to the size and location of your plant site. Consider the type of plants you want and the conditions under which they thrive, and place your plants where the best combination of light, shade, moisture, and drainage prevail. Allow enough space between plants and structures for each plant to grow to maturity without overcrowding its neighbor or hitting a fence, roof, or other structure. I like to outplant the natives together in layered groups which can include a tree, a shrub, a subshrub, a fern, and a ground cover, rather then each plant by itself. It is easier to amend and maintain one large area than several smaller ones. Place the plant in the best setting for the plant — not the best setting for you. If the plants grow naturally in a wet or dry environment, try to meet those needs. Do not outplant cultivated native plants into the wild without the proper permission and proper information on the plant in question; otherwise, you may be harming the gene pool of a distinct species that occurs only in that particular area. Some native species hybridize very easily, cross pollinating within the first flowering season, which can result in cross-pollution of the wild gene pool and the production of hybridized seeds rather than pure, viable wild seeds, as nature intended. Especially in Hawai'i, there are many endemic species of flora found only on one island. Introducing a related native from another island into the wild can have very damaging results.

SOIL PREPARATION

Prepare your soil well ahead of planting time to provide the right texture and nutrients. Roots like a soil that is spongy enough to hold moisture, but porous enough to provide air spaces and good drainage.

NOTE: The more time and effort you put into preparing the plant site's soil, the less time and effort will be required for their upkeep in the future.

Healthy soil grows healthy plants. Insects such as nematodes and diseases are more likely to attack weak, sick plants.

Sandy soils

Sandy soils can drain too quickly, and can be amended by mixing in well-rotted organic materials such as peat moss, compost, and/or well-decomposed manure. Make sure these materials are well decomposed before planting. Be especially careful with raw chicken manure, which can burn plants and will take up extra nitrogen from the soil to help complete decomposition. Plant leaves will turn yellow and drop off.

Heavy soils

Heavy soils that form sticky lumps when wet, or hard clods when dry, have poor drainage, and need to have cinder, gravel, coarse perlite #3, or coarse rinsed sand (with salts rinsed out) added in.

SITE PREPARATION

To prepare a site to outplant, first dig a hole twice as wide as the pot the plant is in; wider for shallow-growing plants such as ferns, herbaceous plants, ground covers, and some subshrubs. Dig the hole a little deeper than the pot for tall trees and shrubs. Amend the soil dug out from the hole accordingly, and sprinkle a small amount of slow-release fertilizer into the bottom of the hole. Add some of the amended soil. Now it is time to carefully remove the plant from the pot by gently loosening the roots and some of the mix around the roots. If the plant is root-bound, carefully undo the circular growth pattern to prevent poor root growth, and place the plant in the hole with the roots directed downward (for trees). Fill in the remaining area with the amended soil and water. The water must drain freely for best results. It is important to outplant the plant at the same depth it was in the pot; plants (especially trees) can easily die by being planted too deep because the

base of the stem or trunk will tend to rot. Be careful that the plant does not sink deeper into the hole after watering in, and over time. Gently pack soil around the plant to provide support; in windy locations, give extra support by tying the plant to a sturdy stake. Remove some of the lower leaves to reduce the effects of transplant shock. Make a moat or dam around the plant with the soil to keep the water from running off when watered. Water weekly when dry, until the plant becomes established, as indicated by new vegetative growth. After the plant is established, only water during prolonged periods of drought.

Polyacrylamide gel

When I worked for the Research Corporation of the University of Hawai'i (RCUH) in Kōke'e, there was no source of water to irrigate the plants in the wild. In this situation, we used polymer, with great success. I highly recommend it as a soil amendment in similar situations.

Polyacrylamide powder (polymer) is a gel-like substance that swells up when water is added. If it is used properly, it can provide a water source for the plant for up to three to four years before breaking down. By this time the plant should be well established and have a healthy root system.

- Add 1 cup dry polymer to a 5 gallon bucket of water. For best results, let sit overnight or for several hours to swell.
- Use 1 cup of wet polymer for a 1-gallon pot size hole.
- Use ¼ cup to ½ cup for four to six-inch pot size. Mix the wet polymer and fertilizer into the soil dug from the hole before planting. Aways water in newly outplanted plants if water is available.

NOTE: In this case, more is not necessarily better. Too much polymer in the planting hole will swell excessively when it rains, and push the plant nearly out of the ground.

NUTRITION AND FERTILIZERS

Plant growth is highly responsive to the proper soil pH (5.0–7.0) and availability of nutrients.

- Nitrogen (N) stimulates new foliage, stem growth, and promotes the dark green color of leaves;
- Phosphorus (P) stimulates root growth, flowering, and fruiting;
- Potassium (K) stimulates overall plant strength;
- To adjust acid soil pH, add dolomite lime;
- To adjust alkaline soil pH, add sulphur.

Organic fertilizer, such as fish emulsion (5-1-1), applied every three to six months as a soil drench is excellent for ferns and sundew (*Drosera*) plants. Foliar feed your seedlings and other potted plants monthly with a water soluble fertilizer such as Miracle Gro® (15-30-15), fertilizing the plant through the foliage and the root system, helping them grow faster and greener. When leaves turn yellow from the lack of nitrogen and/or iron in the plant and surrounding soil, foliar feed with Miracid® (30-10-10) or iron-chelate fertilizers. This especially affects the species in the Rubiaceae and Santalaceae families. Slow release 8-8-8 NPK fertilizers work well for newly transplanted seedlings and smaller sensitive plants; for larger, older plants use a slow-release 10-10-10 NPK fertilizers. Depending on soil moisture, these fertilizers release gradually over a three to six month period, which reduces the possibility of injury from excessive use. Using organic fertilizers also reduces the injury to beneficial soil-borne fungi (*Mycorrhizae*) which live in and on the plant roots, helping them absorb much needed nutrients from the soil, and beneficial nematodes also living in the soil that feed on harmful insects that can damage and kill native plant roots ('ohai).

For a large outplanting, if the potential site soil conditions are uncertain, send a soil sample to your local Agricultural Extension Service. They will advise you on how to amend your soil for maximum growth and productivity. To create a good soil sample, take a shovelful from five to eight places, evenly spaced within the prospective area. Mix the soil together and send a sample in the amount of whatever the local agricultural service requires to conduct their tests.

PEST CONTROL



Mealy bugs — KLR



Hibiscus leaf mite on kokio — KLR

PEST MANAGEMENT Most pest control can be accomplished with a strong water spray from the hose while rubbing off the insects by hand. Native plants do not respond well to harsh insecticides; use botanical insecticides as much as possible. Since native Hawaiian plants evolved in isolation and were not exposed to aggressive herbivores, hoofed animals, and many insects, pests and diseases, they had little competition and lost or did not develop natural defenses or protection. The most damaging pests to cultivated native Hawaiian plants are the introduced insects: aphids, mealybugs, mites, scale, thrips, whiteflies, root-knot nematodes, and ants. Many of these attack the plants from the ground. These hungry insects do not have natural predators or freezing temperatures to keep them under control. Most of these insects thrive on plants with lush new growth caused by high nitrogen levels in the soil that are the result of over fertilization. This new growth is food for the sucking insects. They produce honeydew, which in turn is harvested by ants to feed their nestmates. Whatever pest management system you develop, keeping a consistent and regular application regime is an important part of keeping the pests under control.

Aphids cause foliage to become shriveled and wrinkled, and they also carry diseases (viruses) from plant to plant. They are tiny insects, usually dark green in color and yellow or black, and commonly feed on new growth. Management consists of applying systemic pesticides, neem oil, soap spray, or horticultural oil.

Hibiscus *erineum* leaf mite prefer the Chinese red hibiscus (*Hibiscus rosa-sinensis*), but will also attack other hibiscus species, natives and introduced.

In Hawai'i it was first discovered on hibiscus in 1989 on Oahu, and it is now found on all the main islands. Adult hibiscus *erineum* leaf mites have soft worm-like bodies, invisible to the naked eye. Raised puckered bumps (galls) on the leaves are the plants reaction to the mite feeding. Young leaves and buds are most vulnerable to leaf mite infestation because new plant growth is necessary for mite establishment. (Insect Pests CTAHR April 2001 IP-7)

Mealybugs in large populations can cause a plant to shed its leaves and become stunted or even die. They appear as small puffs of cotton in the joints, the undersides of leaves, in the roots, or any protected crevice on the plant. Management includes applying systemic pesticides, neem oil, soap spray, or horticultural oil.

Slugs eat the leaves and stems of the more herbaceous plants like the *Cyanea, Peperomia,* and *Brighamia.* To control them, use a granular slug bait—or remove them by hand and monitor the plants often, looking for indications such as slime trails.



African snails—KLR



Whitefly on *Hibiscus kokio* leaves—MC



Hibiscus snow scale—KLR

Spider Mites suck chlorophyll from leaves, turning them pale green or yellowish, and cause them to fall off if they are left untreated. Webs occur on the leaves or in plant branch crotches; mites appear as tiny reddish specks moving about. *Brighamia* are particularly susceptible plants. To manage spider mites, rotate the use of insecticides; the red spider mites become immune to the chemical within one generation. Rotate the use of mitecides, neem oil, soap sprays, or horticultural oil.

Scale infested plants are stunted and have yellow leaves. Their branches are ringed with scales, and they may die. Scale insects look like raised, brownish, black, or green spots along the stems and leaf ribs. Applying systemic pesticides, neem oil, soap spray, or horticultural oil can manage scale.

Thrips feed by scraping the undersurface of plant tissues and sucking up the juices that leak out. The leaves of thrip-infested plants appear silver with blackish spots, which is actually their fecal matter. Damage also occurs in the flowers, as in many of the *Hibiscus*. Thrips are very small blackish-brown insects with straight bodies. They can be managed by applying a systemic pesticide or by using horticultural oil. Yellow sticky paper traps help give an indication of what pests are in the area and can help reduce the insects that get trapped on them.

Whiteflies are small, white-winged insects that cluster on the under side of leaves and fly about when disturbed. Plants infested with whiteflies have leaves that turn yellow and fall off if left untreated. They are often in the *Hibiscus* family. To manage whiteflies, wash off the infested area of the plant by hand with a strong spray of water, or use systemic pesticides or horticultural oil.

Spittle Bug infestations resemble spit on the tips of the plants—so much so, that when I first saw them, I honestly thought that someone was spitting all over my plants. Small, green, round beetles live under the spit-like substance. To manage spit bugs, apply a systemic pesticide or wash them off by hand.

Chinese Rose Beetles eat holes in the leaves at night, and in severe cases, cause the plants to become weak because of the reduced amount of leaf surface,



Root-knot nematodes – *Sesbania tomentosa* root — DR

which the plant needs to conduct its photosynthesis. To easily manage rose beetles, set up solar night lights near the top of the plants, deterring the beetles, or apply a systemic pesticide, or use a bacterial insecticide (bacillus) to the plant to poison the beetles.

Black or **Coffee Twig Borers** are destructive little beetles that bore a small hole into the trunk or stem of plants. They lay their eggs in these holes, and when the larvae hatch out, they feed on the pith, causing the plant to die from the hole upwards, (young *Koa* & *Mezoneuron*). Cutting and burning the infested twig or stem will help control the borer, and some plants may grow back from below the bore hole. Plants are more susceptible to bore damage when stressed, unhealthy, or when tree seedlings are younger. Look for a tiny hole and a pile of fine powder in the soil below it. To manage this pest, keep the plants healthy and use a systemic pesticide.

Root-Knot Nematodes are parasitic, microscopic worms that live in the soil and roots of most plants. About a half-million species of nematodes exist in the world today. Some are beneficial, attacking and feeding on harmful insects, while others feed on plants and cause the roots to form galls, blocking the flow of water and nutrients to the plant above and leading to stunted growth, yellowing leaves, and wilt. Plants can take years to die. Fleshy-rooted plants such as *Sesbania*, *Hibiscus*, *Wilkesia*, *Cyanea*, and *Brighamia* seem to be the most affected. To manage nematodes, use a nematicide mixed into the soil at the time of outplanting. Follow the directions on the manufacturer's label closely, or soil drench with neem oil extracts every few months.

Ants are by far the most destructive pests to plants, in and out of the greenhouse. They farm sucking insects that weaken plants (such as aphids, scales, and mealybugs) for the honeydew these insects produce. The ants also protect these insects from their natural predators. You will have to control the ants first, and then the other insects. Use ant bait or insecticide at the base of the plant, being careful not to harm the plant with harsh insecticides. Be consistent with periodic application. If ants become a major problem, the mixture below is effective.

Bait for most Ants

- 1 ½ cups of tap water
- 1 cup white sugar (white works best)
- 1 tablespoon boric acid or borax
- 1 teaspoon creamy peanut butter

Mix in a blender until syrupy. Pour into containers.

Use small plastic containers with lids (such as containers for yogurt or sour cream) to dispense the ant bait. Put between two and four holes in the side of the container near the lid, large enough for the ants to enter. Fill half of the container with the bait mix and make sure the lid is on tight.

Place the containers near the ant holes and observe the worker ants. They will be attracted to it because of the sugar and or the peanut butter; they will sample the bait, and then take it home to the queen and the other ants in the nest. In a few weeks to a few months, depending on the size of the nest, the ants will succumb to the boric acid and dehydrate, die, or move away. I change the ant baits once a month, or when they are empty.

Rodents
Hawai'i has four introduced rodents: the roof rat, Norway rat, the Polynesian rat, and the common house mouse. All of them can be a major nuisance. They will forage on seeds and seedlings in the wild and in a nursery setting. The common signs of rodents are droppings and dig marks in and around the seed flats. To control them, use a trap set with fruit or strong smelling food (half-cooked bacon, peanut butter, or dried shrimp) and be consistent for the best results.

Horticultural oils, neem, pyrethrum, or insecticidal soaps
When used together or alone, horticultural oils, neem, pyrethrum or insecticidal soaps provide sufficient control for the insects discussed. Follow the directions on the manufacturer's label. Native plants are sensitive and can have adverse reactions such as phytotoxicity (when an insecticide is sprayed in the heat of the day, and it can burn the leaves and/or leave a persistent residue). To avoid this, spray in the morning or later in the day when it is cooler. For all pest control measures, consistency is key. As soon as you let up, they will be back and out of control, especially red spider mites. Be sure to rotate these insecticides for the best results.

Soap Spray
- Use Ivory Liquid® dish soap or Simple Green® liquid soap.
- Mix 1 part soap to 10 parts water (1:10)
- Apply with a liquid spray applicator

Systemic pesticides
Systemic pesticides are granular insecticides that are taken up by plant roots. The chemical is then incorporated into the plant, and repels pests. Follow the directions carefully, and take care not to overdo it. I have used systemic pesticides on a wide range of native plants without casualties. Incorporate a small amount in the soil mix or sprinkle on the soil surface then water it in. The chemical must reach the root zone in order for the roots to absorb it. Systemic pesticides work particularly well on the Chinese rose beetle and the sucking insects mentioned.

Manual removal
For small outbreaks of insects, control can be achieved easily by rubbing the insects off by hand, accompanied by a strong spray of water from the hose. When watering, focus the spray to the underside of the leaves where the insects hide. This works well for small outbreaks of red spider mites or whitefly.

WEED MANAGEMENT

Weed management is important for the plant's health and growth. Weeds harbor pesky insects, and compete by taking up the much-needed moisture and nutrients intended for the native plants. At minimum, keep the base of plants weeded to help avoid herbicide and weed-eater damage, which will weaken or kill the plant.

Preemergent for weed control
Applying a preemergent for weed control works well for three to four months by preventing weed seeds from germinating, but it does not kill weeds already established. To apply, top-dress the granular chemical on the soil of potted plants or on the ground surface and water it in. Be consistent and pull any weeds before they flower. This will help you stay on top of weeds, especially during the rainy season. Stop using this product when the native plants mature and produce their own seeds; you will want to see if the seeds fall to the ground and regenerate themselves naturally. These seedlings can be potted or left to grow where they germinated, provided they have room to grow properly.

Herbicides
Native plants are sensitive to strong herbicides, so herbicides should be used with the utmost care. Avoid spraying weeds near the base of your plants. Some of these plants have shallow surface roots that help the plant take up more moisture from the soil; these roots may also take up the chemical and die. Do not spray on windy days; the drift may cause chemical burns to and/or kill nearby plants.



Brighamia insignis **outplanted – NTBG — CC**

Part Two: Native Hawaiian Plant Profiles and Propagation Techniques by Family and Genera

ADDENDUM:

Since the publication of this book in 2005, many changes have been made to Hawai'i's ever changing native plant records based on numerous field trips and molecular evidence (Manual (Wagner et al. 1990)). In this new edition, I have updated island distribution and scientific names for each plant described using a (December 2012 update), indicated by (Syn. synonym) a taxonomic name rejected in favor of another name).

No corrections were made to the plants' endangered levels. They are changing at disturbing rates making it challenging for botanists to keep current.

Hawaiian Native and Naturalized Vascular Plants Checklist (December 2012 update)
Editor: Clyde T. Imada, Hawaii Biological Survey Bishop Museum

Hawaiian Vascular Plant Updates: Version 1.3 (12 April 2012)
Warren L. Wagner, Derral R. Herbst, Nancy Khan, Tim Flynn

AGAVACEAE

(AGAVE FAMILY)

GENUS:
Pleomele

HAWAIIAN NAME:
Hala pepe

COMMON NAME:
Hawaiian Dracaena

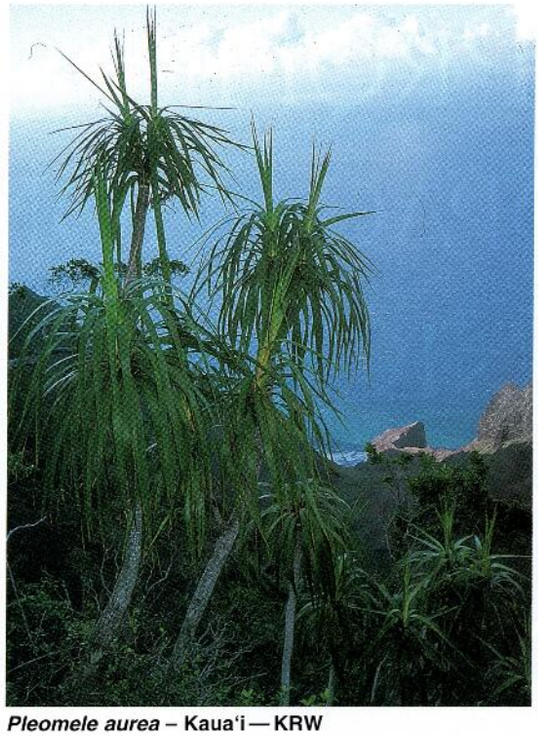
SPECIES	HAWAIIAN RANGE
P. aurea	end[1] (K)
P. auwahiensis	end (M, Mo)
P. fernaldii	end (L)
P. forbesii	end (O)
P. halapepe	end (O)
P. hawaiiensis	end (H)

Partial Sun

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds and cuttings



Pleomele aurea **– Kaua'i — KRW**

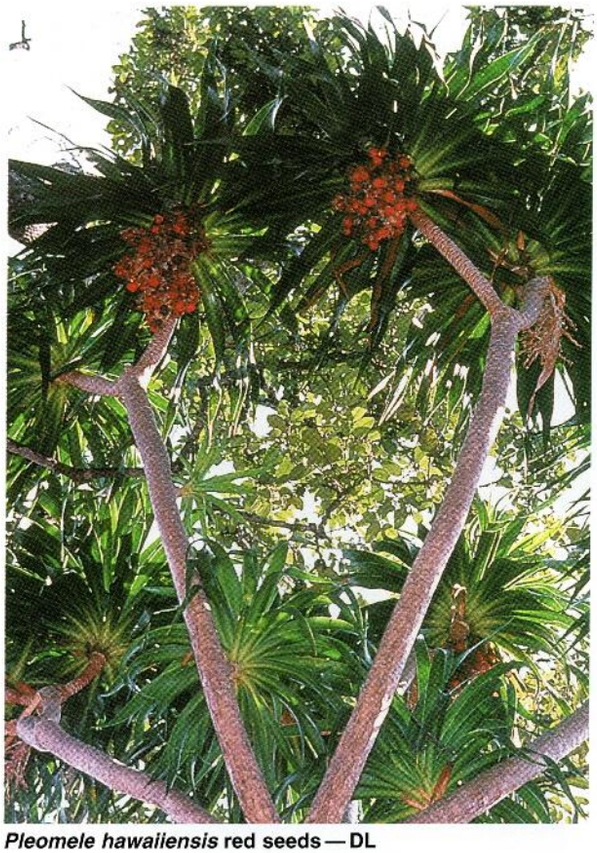


Pleomele hawaiiensis **flowers — DR**

GENERAL DESCRIPTION

The dry forest hala pepe resembles its cousin *Dracaena*. The tubular yellow-orange to yellow-green flowers bloom in late spring, depending on the weather (drought conditions delay flowering and fruiting). The seeds develop in early fall and are ready to collect when their berries are brownish-red in color and are shedding. When the spring and summer have heavier rainfall, the seeds are more viable and the germination rate is increased. I have found that during drought years the seeds are weak and underdeveloped and have poor viability, resulting in little to no germination.

Entire Range: Hawaiian endemic
Wild Habitat: Dry Forest
Habit: Shrub to subshrub with stems solitary to branched
Mature Height: 15–30 ft (4.6–9 m)
Stem/Trunk: Slender, with prominent ringed leaf scars in younger plants
Leaves: Slender, with prominent ringed leaf scars in younger plants
Inflorescence/Flower: Perfect, numerous, in multiples of three, tepals six, white to yellow
Fruit: Globose berries, green ripening to brownish-red
Seed: One to three tan seeds within each berry (Wagner et al. 1990)



***Pleomele hawaiiensis* red seeds — DL**

PROPAGATION AND CULTIVATION

SEEDS

- Collect the ripe, mature fruits and place them in a plastic bag to keep the pulp soft, and for easy removal.
- Remove the seeds from the pulp, and then air-dry them on paper towels; the seeds lack hard seed coats and need to be sown right away.
- No pretreatment is necessary; medium sized seeds can be sown in a mix of 3 parts perlite to 1 part vermiculite or potting soil (3:1), using shallow flats.
- Keep them in a covered, shaded area to control the moisture.
- Keep the mix on the dry side, as the seeds are very susceptible to rot.

GERMINATION

- Germination can take one to four months, depending on the health of the plant at the time of collection (see drought conditions above).
- The seedlings resemble corn seedlings; wait for two to four stiff, true leaves before transplanting.
- Transplant the seedlings into well-draining mix; be careful not to damage the stiff roots, as they can be easily broken.

CUTTINGS

- To propagate by cuttings, both hardwood and semi-hardwood cuttings can be collected. Cut the top foliage in half.
- Apply rooting powders Nos. 3 or 8, with a fungicide.
- Use the recommended cutting mix.
- Cuttings can root in three to six months.
- Follow the protocols for transplanting and applying fertilizers.

AIR LAYERING

- Follow the steps for air layering as recommended.
- Apply rooting powder No. 8.
- Rooting may take four to six months.
- Use a well-draining transplant mix.

OUTPLANTING

- Slow growing hala pepe will will be ready for outplanting in twelve months, or when the plant outgrows a 1–2-gallon pot.
- They occur naturally in dry to mesic forests, and will thrive best in partial sun.
- Amend the planting hole with cinder and soil to ensure that it will be well-draining.
- Apply an 8-8-8 NPK fertilizer every six months.
- Water weekly at first; once they are established, water during times of drought.

PESTS

- Infestations of root mealybugs, mites, and thrips can occur. If they do, control them as recommended; systemic pesticides are the most effective.

[1] See Appendix 1 for abbreviations used with text.

A

AIZOACEAE
(FIG-MARIGOLD FAMILY)

GENUS:
Sesuvium

HAWAIIAN NAME:
ʻĀkulikuli

COMMON NAME:
Sea purslane

SPECIES	STATUS	HAWAIIAN RANGE
S. portulacastrum		ind (Le, HI)

Full Sun

Range
Indigenous

Description
ground cover

Propagation
seeds and cuttings



***Sesuvium portulacastrum* flower — DL**

GENERAL DESCRIPTION

ʻAkulikuli is similar to portulaca in appearance and are easily propagated. It is a good choice for a coastal restoration project, planted with *Nama*, dwarf naupaka and *Ipomoea* to name a few.

Entire Range: Indigenous, pantropical; in Hawai'i: Pearl and Hermes Atoll, Lisianski, Laysan, Necker, and all main Hawaiian Islands

Wild Habitat: Occurs in a variety of coastal habitats

Habit: A succulent, herbaceous, fleshy, low, spreading plant with many branches that root at the nodes

Mature Height: Low-growing to about 0.5 m height

Stem/Trunk: Succulent, green and turns yellowish or red with age

Leaves: Small narrow flattened green leaves, opposite, that turn yellowish or red with age

Inflorescence/Flower: Pinkish, singular, star-shaped, perfect flowers, borne at leaf axils

Fruit: Tan, ovoid-subglobose capsules about 4–7 mm long

Seed: Lenticular-reniform (lens to kidney-shaped), 1–1.5 mm in diameter, 10–30 per capsule (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

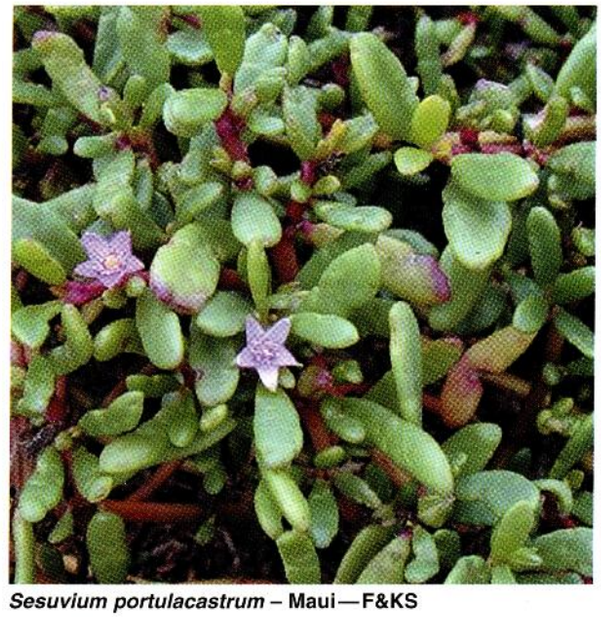
- To propagate by seed, first collect the capsules when they are dry and tan.
- Handle and clean them as directed for cleaning dry seeds.
- No pretreatments are necessary.
- Surface sow the tiny seeds on a seed mix in a shallow flat and water them in.
- Keep your seed mix on the dry side, in a covered area.

GERMINATION (fast)

- Germination may take two weeks to three months for all of the viable seeds to sprout.
- Transplant them into 2-inch pots after four to six true leaves have appeared.
- Use a sandy, well-draining mix.

CUTTINGS (easy)

- Take herbaceous stems cuttings about 3–5 inches long.
- In a shallow flat, stick one to two nodes below a mix made of.
- 3 parts perlite to 1 part vermiculite (3:1) works best, water cuttings in, then water every three days or when dry.
- Rooting will take place in one to two months.



Sesuvium portulacastrum **– Maui—F&KS**

- Wait until the cuttings are well rooted, then transplant them into shallow pots with a well-draining sandy soil:

  2–3 parts perlite or cinder to 1 part bagged potting mix, or 1 part light sandy soil. Keep mix dry, watering twice a week.

OUTPLANTING

- They will be ready for outplanting in about three months, when they have outgrown a 4-inch pot.
- Outplant them into an area with full sun, and with well-draining sandy soil, great for coastal projects.
- Water your plants for the first two weeks, and then water them only in times of prolonged drought.

PESTS

- Slugs love to feed on these succulent, herbaceous plants; they can be controlled by applying the recommended slug bait.

AMARANTHACEAE

(AMARANTH FAMILY)

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
ground cover to trees[1]

Propagation
seeds and cuttings

1: Description doesn't apply to all genera.

GENUS:
Achyranthes

SPECIES	STATUS	HAWAIIAN RANGE
A. atollensis	Ex/E	end (NWHI)
A. mutica	E	end (ex. K, H)
A. splendens var. *rotundata*	R/E	end (O, Mo, L)
A. splendens var. *splendens*		end (L, M)



***Achyranthes splendens* var. *splendens* – NTBG native Haw. section — MC**

GENUS:
Amaranthus

SPECIES	STATUS	HAWAIIAN RANGE
A. brownii	E	end (NWHI)



***Amaranthus brownii* — SC**

GENUS: ***Charpentiera*** HAWAIIAN NAME: **Pāpala**

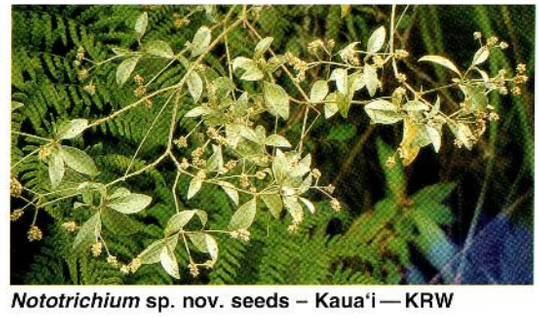
SPECIES	STATUS	HAWAIIAN RANGE
C. densiflora	V	end (K)
C. elliptica	AS	end (K)
C. obovata	—	end (HI exc. Ni, Ka)
C. ovata var. *niuensis*	AS	end (O)
C. ovata var. *ovata*		end (O, Mo, M, H)
C. tomentosa var. *maakuaensis*		end (O)
C. tomentosa var. *tomentosa*	AS	end (O, Mo, L, M, H)



***Charpentiera densiflora* in flower – Kaua'i — KRW**

GENUS: ***Nototrichium*** HAWAIIAN NAME: **Kulu'ī**

SPECIES	STATUS	HAWAIIAN RANGE
N. divaricatum	R	end (K)
N. humile	E	end (O, M)
N. sandwicense	—	end (HI)



***Nototrichium* sp. nov. seeds – Kaua'i — KRW**

GENERAL DESCRIPTION

The small, green seeds are found at the top of spikes above the foliage. As they mature, they darken and fall easily from the plant. *Nototrichium* is an endemic genus found exclusively in the Hawaiian Islands (true Hawaiian).

Entire Range: Hawaiian endemic species

Wild Habitat: Dry forest, dry lowland regions, diverse mesic forests, and mesic forests

Habit: Perennial herbs (*Amaranthus*), shrubs (*Achyranthes*, *Nototrichium*), small trees, trees (*Charpentiera*)

Mature Height: 3–35 ft (1–1.2 m)



***Nototrichium humile* seeds – O'ahu — SP**

Stem/Trunk: Woody, branching, erect, or decumbent

Leaves: Simple, alternate or opposite, margins usually entire, stipules absent; leaf surfaces have silvery tomentose with gray-green foliage to glabrous

Inflorescence/Flower: Flowers are perfect, in simple or compound cymes arranged in head-like, or spike-like, or paniculate, axillary or terminal clusters, or occasionally the flowers are solitary, the ovary is superior.

Fruit: A utricle, nut, or circumscissil, one-seeded capsule; the one-seeded capsule, sometimes breaks open irregularly, often enclosed by the persistent calyx

Seed: There is one seed per utricle, the surface is lustrous, and the endosperm is essentially absent (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- Collect the small dry seeds from branch ends when they mature and fall off the plant.
- Handle and clean them as recommended for dry seeds.
- To prepare them, use a twenty-four hour soak in tap water for *Achyranthes*; no pretreatment necessary for smaller seeds of *Amaranthus*, *Charpentiera*, and *Nototrichium*.



***Achyranthes* seed heads – NTBG, nat. Haw. sec. — DR**

- Sprinkle small seeds onto mix, and then add ¼ inch layer of mix on top of seeds.
- The seeds can be stored in a desiccation chamber or refrigerator for up to eight years.

GERMINATION

- Germination occurs in two weeks to five months, depending on the health of the mother plant at the time of collection.
- Transplant into a well-draining mix after four to six true leaves appear.

CUTTINGS (easy)

- To make cuttings, use semi-hardwood and softwood cuttings.
- *Nototrichium* does not need a rooting powder treatment.
- Rooting powder No. 3 works well for the other genera and species.
- Cuttings will root in two to three months, after which transplant them into a well-draining mix.

OUTPLANTING



***Nototrichium sandwicense* – Kaua'i — KRW**

- These are relatively fast-growing plants and will be ready for outplanting in six to eight months when started as cuttings or seeds.
- Choose a site in full sun for *Achyranthes*, *Amaranthus*, and *Nototrichium* because they naturally occur in open dry forest areas.
- *Charpentiera* occurs in wet to mesic forests and needs partial shade with more moisture; it may take one year before the *Charpentiera* can be outplanted.

PESTS

- Aphids and root mealybugs can be pests. Use the recommended treatments, and spray with horticultural oils.
- Keeping your plants healthy also helps control and reduce bug infestations.

A

ANACARDIACEAE

(MANGO FAMILY)

GENUS:
Rhus

HAWAIIAN NAMES:	COMMON NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Neleau; neneleau	**Hawaiian sumac**	*R. sandwicensis*	—	end (K, O, Mo, M, H)

Full Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds



***Rhus sandwicense* flowers — JO**

GENERAL DESCRIPTION

Rhus is a shrub to small tree with many root suckers, which produce dense patches of vegetation, good hardy hedge material. The tiny, pale-yellow flowers are at the end of the branches; they ripen into red fruits. I have not had much experience with growing this genus. Its exotic relatives are weedy in Hawai'i and are very easy to grow.

Entire Range: Hawaiian endemic
Wild Habitat: Scattered in wet to dry disturbed areas, along roadsides, pastures
Habit: Small tree
Mature Height: 15–25 ft (3–8 m)
Stem/Trunk: Soft, light, yellowish-gray, flexible, woody, with milky sap, producing numerous suckers, forming dense patches
Leaves: Green on upper surface, lower surface paler, new leaf growth red; compound
Inflorescence/Flower: Perfect, in dense reddish-brown tomentose; five-merous: sepals five; lanceolate, margins ciliate; petals five, pale yellow, elliptic; stamens five
Fruit: Drupes red, globose, tomentose
Seed: One, on a basal stalk
Uses: Wood for plows, yokes, and bark for tanning (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruit (drupes) when they are ripe and red.
- Clean and handle the fruits as recommended for small pulpy fruits.
- Soak the seeds for twelve to twenty-four hours, and then air-dry them.
- Sow the small seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) in a shallow flat, then sprinkle ¼ inch of mix on top of them.
- Keep them in a shaded, covered area.

GERMINATION

- It usually takes one to six months for all viable seeds to sprout.
- Transplant them into 2-inch pots after two to four true leaves appear.
- Keep them in the shade for a month or so, then move them into more sun to harden them off.

OUTPLANTING

- Your plants will be ready for outplanting when they have outgrown a 1-gallon pot.



Rhus sandwicensis **– Maui — F&KS**

- Choose a location with full to filtered sun, and amend the soil for drainage.
- Protect the plants from strong winds at first.
- Water weekly for two to three months, then water during times of drought.

PESTS

- Control the ants and weeds at the base of the tree, as recommended.



Rhus sandwicensis **fruit — F&KS**

APIACEAE

(PARSLEY FAMILY)

GENUS: ***Peucedanum***

HAWAIIAN NAME: **Makou**

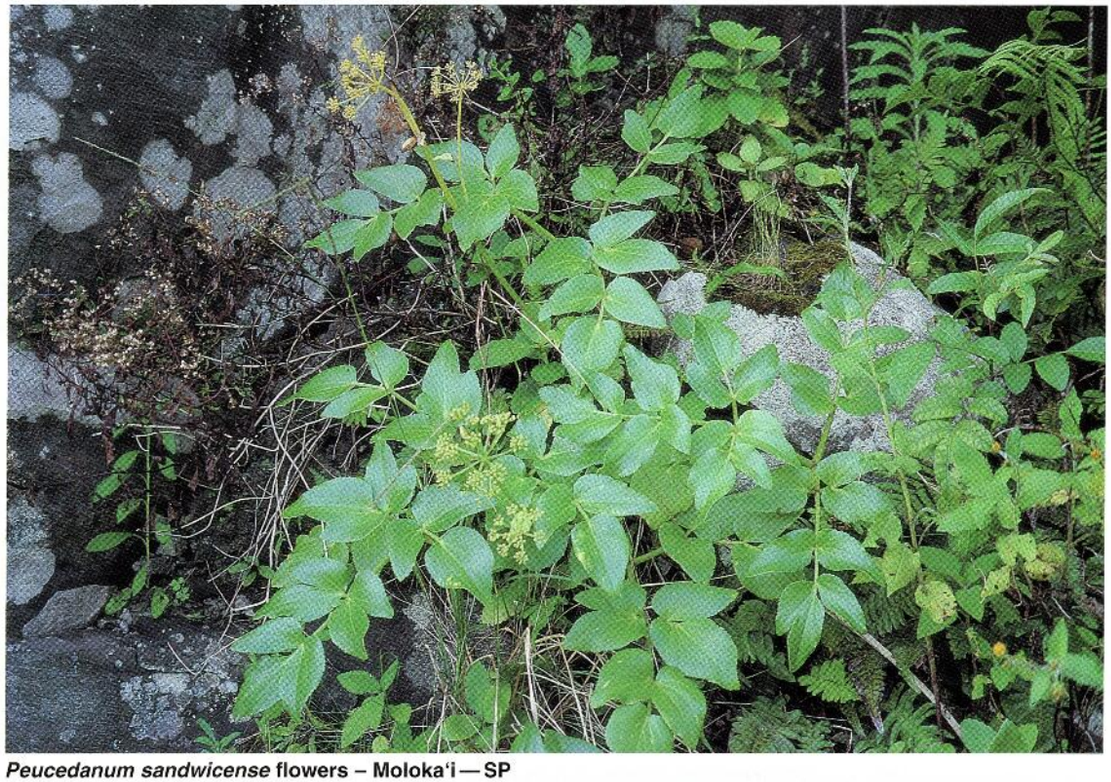
SPECIES	STATUS	HAWAIIAN RANGE/ HABITAT
P. sandwicense	E	end (K, O, Mo, M) windward cliffs

Partial Sun

Range
Hawaiian Endemic

Description
upright perennial herb

Propagation
seeds

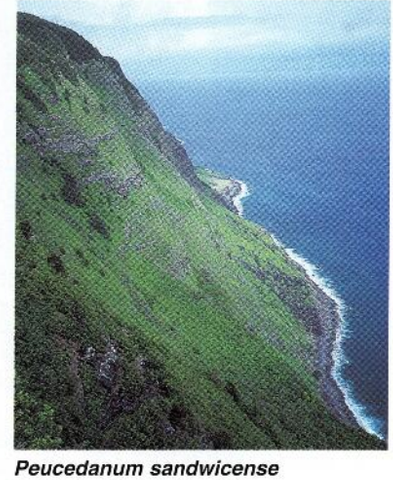


***Peucedanum sandwicense* flowers – Moloka'i — SP**

GENERAL DESCRIPTION

Makou is a small upright perennial herb with a strong parsley scent, green fleshy stems, and thick, succulent taproots. The light-green leaflets are arranged opposite and in pairs of threes. Numerous tiny flowers develop at the top of long spikes with tiny spreading branches (umbrella-shaped); these mature into many dry fruits. The fruits have separate chambers, each chamber containing one seed. This is a fairly easy plant to grow and maintain in the landscape. It does best when planted at the base of trees. I have some planted at the base of a hāpu'u tree fern in cindery soil. They grow very well, particularly during the rainy season. During the dry season, the plants shed their leaves, the taproot is alive and will continue to grow.

Entire Range: Hawaiian endemic
Wild Habitat: Occurs on windward cliffs, 1–250 m
Habit: Stout, erect or sprawling perennial herbs
Mature Height: 6–12 in. (5–10 dm)
Stem/Trunk: Short caudex bearing a circle of several fleshy roots, glabrous and glaucous
Leaves: Pinnately compound, palmately veined, margins serrate



***Peucedanum sandwicense* habitat – Moloka'i — SP**

Inflorescence/Flower: Flowers in fertile terminal umbel, petals white

Fruit: Oblong to oblong-ovoid, flattened, lateral ribs winged

Seed: Flattened in transection

Uses: Root was once used medicinally for some children's diseases (Wagner et al. 1990)

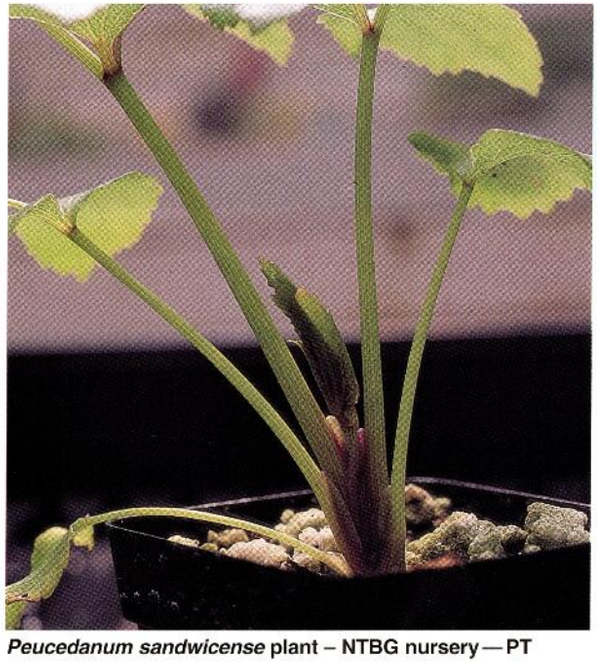


***Peucedanum sandwicense* seedlings – NTBG nursery — PT**

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the dry fruits and keep them dry in a paper bag. **Note**: these seeds do not require cleaning.
- The seeds can be stored dry in the refrigerator or in a desiccation chamber for up to eight years, but they will lose some viability.



***Peucedanum sandwicense* plant – NTBG nursery — PT**

- Pretreat the seeds with a twenty-four hours tap water soak; the seeds will float because of the trapped air pockets in the seed coat.
- Sow the seeds onto a mixture of 3 parts perlite to 1 part potting mix (3:1), then cover them with ¼ inch of mix.
- Keep them in a covered area and water them every other day.

GERMINATION

- All viable seeds will germinate in one to four months.
- Wait until four true leaves develop, then transplant them into 2-inch pots with a well-draining mix.
- Keep them in a shaded area, and foliar feed them monthly.
- Repot them into larger 4-inch pots in two to four months.
- Move them into partial sun to harden them off before outplanting.

OUTPLANTING (short-lived perennial plant)

- Your plants will be ready for outplanting in six months to a year, when they are growing healthily and have outgrown a 4- to 6-inch pot.
- Plant them among other plants such as trees, shrubs, and ferns in partial shade.
- Choose a site with well-draining soil, or amend the soil with cinder; these plants occur naturally on cliffs.
- Do not plant them too deep; the top of the taproot should be at soil level.
- Water the plants in, and then water them weekly until they become established, followed by monthly foliar feeding.
- *Peucedanum* will regenerate themselves in the garden if the seeds are allowed to fall to the ground to germinate.
- This unusual plant will shed its foliage during the dry months. New foliage will grow during the rainy season; the entire time, the succulent taproot is alive and will continue to grow.

PESTS

- Slugs and ants are major pests to makou; use the recommended bait for controlling infestations.

APIACEAE

(PARSLEY FAMILY)

GENUS: *Sanicula*	COMMON NAME: Snakeroot	
SPECIES	**STATUS**	**HAWAIIAN RANGE**
S. kauaiensis	E/Ex	end (K)
S. mariversa	E	end (O)
S. purpurea	E	end (O, WM)
S. sandwicensis	R	end (M, H)

GENUS: *Spermolepis*		
SPECIES	**STATUS**	**HAWAIIAN RANGE**
S. hawaiiensis	E	end (K, O, Mo, L, M, H)

Full Sun–Partial Sun[1]

Range
Hawaiian Endemic

Description
short-lived annual or perennial herb

Propagation
seeds

1: Sun requirements differ for each species.



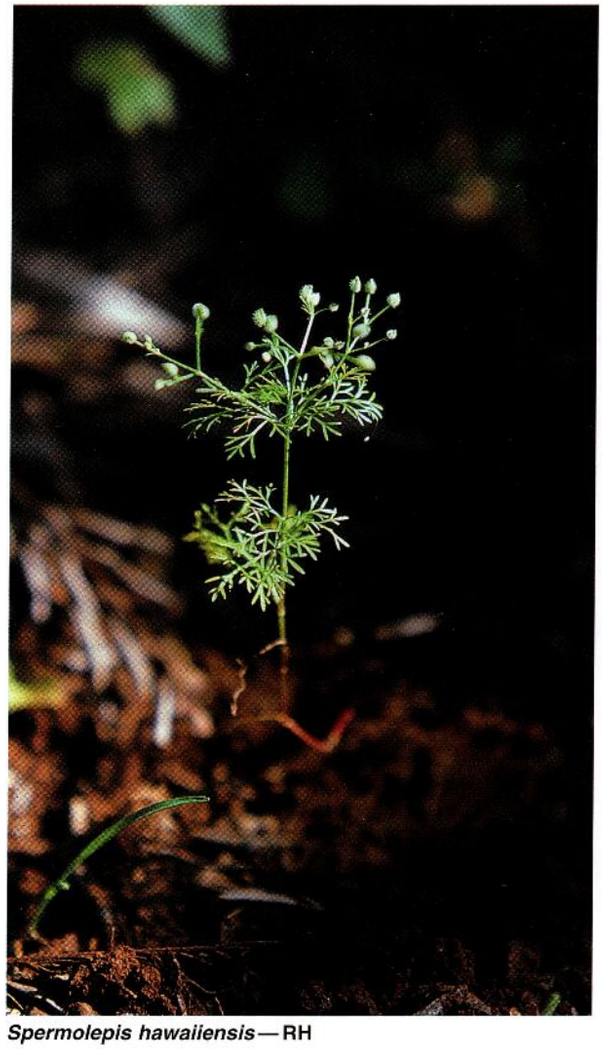
***Sanicula mariversa* flowers — SP**

GENERAL DESCRIPTION

Both of these fleshy green annuals or perennial herbs are short-lived and resemble their relative, the parsley. Like parsley, they also have taproots that are tapered at both ends. They produce an abundance of viable seed within a short period of time and can actually become weedy in the garden. Yet in this case they are a welcome, rare "weed" worth taking care of.

Entire Range: Hawaiian endemic

Wild Habitat: Precipitous grassy slopes (*S. kauaiensis*); well-drained slopes (*S. mariversa*); precipitous slopes to open bogs, rarely in low wet forest (*S. purpurea*); scattered in subalpine shrubland and woodland (*S. sandwicensis*); open areas, and cultivated fields (*S. hawaiiensis*)



***Spermolepis hawaiiensis*—RH**

Habit: Low, slender, erect perennial or biennial herbs (*Sanicula*); slender, erect or spreading, caulescent annual herbs from slender tap roots (*Spermolepis*)

Mature Height: 3–28 inches (0.8–7 dm)

Stem/Trunk: Low or slender, usually erect (*Sanicula*); stems, slender, erect (*Spermolepis*)

Leaves: Leaves simple to compound (*Sanicula*); pinnately decompound with linear divisions (*Spermolepis*)

Inflorescence/Flower: Capitate inflorescences, cymes, or racemes (*Sanicula*); flowers loose umbels, peduncles (*Spermolepis*)

Fruit: Mericarps

Seed: Seed face plane to sulcate (*Sanicula*); grooved beneath vittae (*Spermolepis*) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the tiny dry fruits and keep them dry in a paper bag.
- Follow the recommended cleaning method for dry seeds.
- Sow the seeds onto a dry mixture of 3 parts perlite to 1 part potting mix (3:1) then water them in; the tiny seeds will settle in the mix to the depth they prefer.
- Keep them in a covered area protected from heavy rains, and water them every other day.

GERMINATION

- All viable seeds will germinate in one to four months.
- Wait until four true leaves develop, then transplant them into 2-inch pots with a well-draining mix.
- Keep them in a shaded area; foliar feed them monthly.
- Repot them into larger pots in two to four months to allow the taproots room to grow down.
- Move them into partial sun to harden them off before outplanting.

OUTPLANTING (short-lived perennial plant)

- These plants can be left in a pot for their short lifetime, or outplanted in four to six months into an area with full to partial sun and with cindery soil; amend and fertilize the soil.
- The seeds they produce will germinate readily if left to fall into the pot or onto the ground.
- Plant them among other plants such as trees and shrubs for extra protection.
- Do not plant them too deep; the top of the taproot should be at soil level.
- Water the plants in, and then water them weekly until they become established, foliar feeding monthly if they look weak or the soil is unhealthy.

PESTS

- Slugs can be a major pest to *Sanicula* and *Spermolepis;* use the recommended slug bait to control infestations.

APOCYNACEAE

(DOGBANE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	HAWAIIAN RANGE
Alyxia	Maile	*A. stellata*	ind (HI)



Maile flowers — KJ

Partial Sun

Range
Indigenous

Description
woody vine

Propagation
seeds

GENERAL DESCRIPTION

Maile is diverse both ecologically and morphologically. Usually, this liana (woody vine) twines or clambers up or over other plants in the wild. Its glossy leaves have variable shapes, depending on location. The small, yellow flowers mature into olive-shaped, purplish-black fruit. All parts of the plant contain coumarin, which emits a pleasant odor. Because of this, the maile was integrated into the Hawaiian culture as a very important and cherished plant, particularly for lei making. It can be grown easily as a backyard plant, making it readily accessible to the lei maker. My 20 year old maile vine climbed up and over native trees planted nearby, eventually killing them. Maile can become weedy if used in a landscape design. Keep trimmed or harvest for leis.

Entire Range: Indigenous to Hawai'i

Wild Habitat: Well adapted to a diversity of habitats including: dry open sites, mesic forests to closed wet forests

Habit: Twining liana (woody vine), scandent shrub, and sometimes a small erect shrub

Mature Height: 3–10 ft (1–3 m)

Stem/Trunk: Woody with milky sap

Leaves: Leaves variable, glossy above, paler below, glabrous (smooth, without hairs or glands), fragrant when crushed, margins entire, ternate (arranged in threes) or opposite, leaf shapes vary from lanceolate (lance-shaped) or ovate (egg-shaped) to linear-lanceolate, elliptic, or sub-orbicular (almost circular in outline)

Inflorescence/Flower: Flowers small, in axillary (arising from axil), umbellate cymes, peduncles (flower stalks) 1–1.5 cm long, corolla (petals) greenish to yellowish white

Fruit: Ovoid drupe, consisting of two to three one-seeded joints, ripening to dark purplish, pulpy fruit

Seed: One ovoid, furrowed seed per carpel (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- *Alyxia* is the easiest genus to propagate and grow within this family.
- Maile seeds have a high germination rate if the seeds are sown when fresh.
- It is important to collect the fruits (drupes) when they are mature, ripe, and the flesh is pulpy and purplish-black.
- Do not allow the pulp to dry around the seeds as this will reduce their viability. This can be prevented by keeping the fruits in a plastic bag to soften them. Alternatively, soak the seeds in water for an hour and clean off the pulp as directed.
- Start the seeds when they are fresh, with no pretreatments. Maile seeds do not tolerate desiccation or storage, and they lose their viability as they dry out and age.
- Sow as directed for medium sized seeds, using 3 parts perlite or 3 parts fine black cinder to 1 part potting mix (3:1) in a shallow flat.
- Cover the seeds with ½-inch layer of mix on top of the seeds.
- Keep them in a shaded, protected area and water them every other day. Do not let the mix dry out at any time.

GERMINATION

- Maile germinates over time; it may take it from one to six months for all viable seeds to sprout.
- Transplant the maile seedlings as they sprout and after they grow at least two true leaves. **Note**: it is important to handle the delicate seedlings only by the leaves or root-ball, and not by their very delicate long stems that can be easily injured.
- Maile do best in well-draining cinder soil or coarse perlite No. 3 used for added drainage within the potting mix.
- Keep the transplanted seedlings in a shaded area, and then gradually move them into an area with partial sun to harden them off for outplanting.
- Or they can be repotted into larger pots at this stage.



Maile seedlings – NTBG nursery — KLR

OUTPLANTING

- The maile will be ready for outplanting in six months to one year or when it has outgrown a 1-gallon pot.
- Provide something for the maile to grow upwards into or to grow over, such as a tree.
- Choose an area protected from strong winds. The area needs well-draining soil, or amend the site as directed. Add a small amount of 8-8-8 NPK fertilizer. Polymer can be used in areas that need help retaining soil moisture.
- Water them for the first month until the plants are established, then water only in times of drought.
- In tropical regions, it is best to plant maile during the rainy season.

PESTS

- Ants can be a pest of *Alyxia*. They set up camp at the base of the plant as they farm insects. Use the recommended ant treatment for control.
- Insects such as mealybugs or scales may occasionally be a problem. Control them as recommended.

APOCYNACEAE

(DOGBANE FAMILY)

GENUS: ***Ochrosia***

HAWAIIAN NAME: **Hōlei**

SPECIES	STATUS	HAWAIIAN RANGE
O. compta	—	end (O, Mo, M)
O. haleakalae	R	end (M, H)
O. kauaiensis	R	end (K)
O. kilaueaensis	E	end (H)

Partial Sun–Full Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Ochrosia haleakalae* in fruit – Maui — SP**

GENERAL DESCRIPTION

Ochrosia is a small tree, occurring in dry to mesic forests. The flowers are yellow and fragrant and occur in small clusters at the end of the branches. Each yellow fruit contains one large seed. These plants are so endangered that they often inbreed within small populations. The resulting seeds have very inconsistent viability. I have noticed that the drier the season, the less likely the seeds will be viable or capable of germination.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Small, glabrous trees
Mature Height: 10–30 ft (3–10 m)
Stem/Trunk: Woody with milky sap
Leaves: Two per node, coriaceous, oblong-elliptic, or oblanceolate, conspicuous veins on lower surfaces, margins entire, petiolate

Inflorescence/Flower: Numerous in subdichotomous compound cymes borne from leaf axils, often one flower opening per day, subtended by small bract

Fruit: Drupaceous, yellow to dark-purple fruit at maturity, firm and fleshy, drying hard, usually with both ovaries maturing

Seed: One, ovate, strongly flattened seed (Wagner et al. 1990)



***Ochrosia compta* flowers and fruit—SP**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits (drupes) when they are mature and yellow-brown in color.
- Do not let the fruit dry around the seeds; keep them in a plastic bag to soften them.
- If the fruit is already dried around the seeds, soak them for one to two hours in water to soften them.
- Remove the softened pulp by hand. A pocketknife may be helpful. Make sure all the pulp is removed (the pulp contains germination inhibitors and will also contaminate the seed mix).
- *Ochrosia* seeds do not store well; they have a thin endocarp (covering that protects the embryo) with large embryos, which do not tolerate drying out.
- For the best germination results, sow the seeds right away.
- For pretreatment, all the seeds need is a tap water soak to soften the pulp and help with its removal. If fungal growth is a concern, soak them in a fungicide for ten minutes (follow the directions carefully on the label). Let the seeds air-dry on a paper towel.
- Lay the cleaned, air-dried seeds flat on a mix made up of 3 parts perlite to 1 part potting mix (3:1); then place 1 inch of mix on top of the seeds. Water them every other day, and keep them in a covered, shaded area.

GERMINATION (low rates)

- *Ochrosia* have poor germination rates. It may take from three to six months for them to germinate.
- Transplant them into 4-inch pots after two to four true leaves develop.
- Use a well-draining mix that drains freely through the pot.

CUTTINGS

- The tree must be healthy in order for the cuttings to root; it is a waste of time and material to attempt cuttings if the tree is stressed in any way.
- I have never had success with cutting material from this genus; the cuttings have never been healthy enough.

OUTPLANTING

- You can outplant your *Ochrosia* when it is twice as tall as a 1–2-gallon pot, or in one to two years.
- Choose a location with full to partial sun, that has well-draining soil, and amend the soil as recommended.
- Water them weekly for the first couple of months, then water only in times of drought.

PESTS

- Ants can be a pest of *Ochrosia*; they set up camp at the base of the plant as they farm insects. Use the recommended ant treatment for control.
- A wayward weed-eater can strip the bark from the tree, girdling it and causing it to weaken or even die. There are expanding plastic guards available that can protect the base of woody plants from weed-eaters; another option is to handweed near these species to reduce injury.

APOCYNACEAE

(DOGBANE FAMILY)

GENUS: ***Pteralyxia***

HAWAIIAN NAME: **Kaulu**

SPECIES	STATUS	HAWAIIAN RANGE
P. kauaiensis	R	end (K)
P. macrocarpa	—	end (O)

Shade

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Pteralyxia kauaiensis*— KRW**

GENERAL DESCRIPTION

Kaulu is a mesic to wet forest tree with small yellow flowers at the branch ends. This genus is probably an old Hawaiian resident, and is only found on the older islands Kauai and Oahu. The large red fruits (drupes) are oblong and about 2 inches long. When the pulp is removed, one large, beautifully winged seed is revealed. I wonder if Hawaiians wore these seeds in leis? The seeds have low germination rates, most likely from a weakened gene pool caused by degraded habitats and limited populations that result in inbreeding depression.

Entire Range: Hawaiian endemic

Wild Habitat: Diverse mesic to wet forest

Habit: Tree

Mature Height: 1–50 ft (3–15 m)

Stem/Trunk: Woody with milky sap, thick branches with conspicuous lenticels

Leaves: Alternate, coriaceous, oblanceolate to broadly ovate, orbicular, or elliptic, lateral, veins, and margins entire, petiolate, each axil has a single scale-like gland which has brownish secretions

Inflorescence/Flower: Flowers five-merous, in congested, terminal, simple or compound cymes; corolla tubular with stamens not exserted; lobes pale yellow; two ovules per ovary, two ovaries per flower

Fruit: Drupaceous, ripening to bright red, firm, fleshy, usually only one ovary maturing, endocarp woody, boat-shaped with two lateral wings; these are solid or fenestrated (having openings or translucent areas like windows)

Seed: One seed per ovary, filling the endocarp (Wagner et al. 1990)



***Pteralyxia macrocarpa* fruit – O'ahu — SP**

PROPAGATION AND CULTIVATION

SEEDS (difficult)

- To propagate by seed, first collect pulpy drupes when they are mature and red in color.
- Do not let the pulp dry around seeds. Keep them in a plastic bag to soften them.
- If the pulp is dry and hard to remove, soak them in tap water for an hour to soften the pulp.
- Remove all of the pulp by hand; this can be accomplished with the help of a pocketknife or other tool.
- Optional: soak the cleaned seeds in a fungicide for ten minutes. The viable seeds will sink; discard any of the floating seeds. Then air-dry the seeds for no longer than a day, out of direct sunlight.
- Lay the seeds flat in pots on leveled seed mix made up of 3 parts perlite to 1 part potting mix (3:1). Then cover the seeds with ½ inch of mix.
- Water the seeds in. Then water them every other day. The seeds will be visible in the mix.
- Keep them in a shaded, covered area protected from rats and birds.

GERMINATION (low rates)

- Germination can take from three to six months for a single pinkish root to emerge from the end of the seed. In general, the *Pteralyxia* has poor germination rates.
- Handle seedlings only by their leaves, not their stems. Pot them into 5-inch tall pots soon after germination, and handle them carefully, as the root tip can be very brittle and easily broken. Tree seedlings need pots with enough depth to allow the roots to grow straight and healthy.
- Use a well-draining transplant mix.

OUTPLANTING

- The *Pteralyxia* is ready for outplanting when the tree is growing healthily and is twice as tall as a 1- or 2-gallon pot, usually in about one to two years.
- In the wild, the *Pteralyxia* grows naturally in diverse mesic forests, preferring shady and moist conditions.
- Make sure the soil has been properly amended for good drainage.
- Fertilize every three to six months or foliar feed monthly.
- These trees require close monitoring after they have been outplanted, and they need extra tender care.

PESTS

- Ants can both invade the pot and take up camp at the base of the tree. Use the recommended ant control.

A

APOCYNACEAE

(DOGBANE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Rauvolfia	**Hao**	*R. sandwicensis*	—	end (HI exc. Ka)

Full Sun

Range
Hawaiian Endemic

Description
tree or shrub

Propagation
seeds



***Rauvolfia sandwicensis* – hao flowers — KJ**

GENERAL DESCRIPTION

Hao grows in dry shrublands to mesic forests, as small trees to large shrubs depending on environmental factors. The fruits are two-parted green drupes that turn soft and black when mature and contain one to two stony brown seeds. *Rauvolfia* is easier to grow than *Ochrosia* or *Pteralyxia*, genera that are more threatened.

Entire Range: Hawaiian endemic

Wild Habitat: This genus within Apocynaceae occurs in a great diversity of habitats, much more so than the other genera. Its wild habitat includes mesic forest to open remnant dry forests, lowland wet forests, and lava flows.

Habit: Trees or shrubs

Mature Height: 10–30 ft (3–10 m)

Stem/Trunk: The branches are short, stiff, and striate (fine, longitudinal streaks or marks); with prominent leaf scars

Leaves: The leaves are smooth and green, and they tend to cluster at the branch ends

Inflorescence/Flower: Tiny, fragrant, funnel-shaped, whitish-green flower clusters develop from the leaf axils

Fruit: A bilobed drupe, green ripening to purplish-black, obcordate, about 8–16 mm long, and about 8–16 mm wide

Seed: The seeds are strongly flattened, about 1 cm long and 0.5 cm wide (Wagner et al. 1990)



Hao flowers and fruit – O'ahu — SP

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect mature fruits when they are black in color; keep the pulp soft in a plastic bag for easy removal.
- Soak the seeds in tap water for twenty-four hours, and then remove the pulp. Discard the floaters, and air-dry the seeds for a day.
- For best germination results, sow the medium-sized seeds of the hao right away. Use a mix made up of 3 parts perlite to 1 part potting mix (3:1).
- Keep them in a covered, shaded area, and water them every other day.

GERMINATION

- The seeds come up sporadically after two to six months. Transplant them as they germinate.
- Pot up the seedlings into 4-inch pots after two to four true leaves appear.
- Keep the potted seedlings shaded for two weeks, and then gradually move them into more sun, to harden them off for outplanting.

OUTPLANTING (fast-growing)

- These plants are fast-growing and may be ready for outplanting in six months or when they are twice as tall as a 1-gallon pot. It is best to outplant the fast-growing trees when they are young. This allows them to develop better root formation and stability.
- Provide a location that is sunny or has filtered light.
- Amend the hole for good drainage. If the soil stays too wet, the plant could rot and die.
- **Note**: The hao makes a good tree for the maile vine (*Alyxia*) to grow into. They grow well with each other. The hao has great potential as an attractive landscape tree, with its small clusters of fragrant flowers.

PESTS

- Some of the major pests include ants, which farm other pests, and weeds. These occur at the base of the tree and weaken the plant. Use the recommended protocols for ants and weeds.

AQUIFOLIACEAE

(HOLLY FAMILY)

GENUS:

Ilex

HAWAIIAN NAMES:

Kāwa'u; 'aiea (Kaua'i)

COMMON NAME:

Hawaiian Holly

SPECIES	STATUS	HAWAIIAN RANGE
I. anomala	—	ind (HI exc. Ni, Ka) common in mesic to wet forests and bogs

Partial Sun

Range
Indigenous

Description
tall tree

Propagation
seeds and cuttings



Ilex anomala **– Kaua'i — DL**



Ilex anomala **fruits — JO**

GENERAL DESCRIPTION

Kāwa'u is a tall, slender tree with shiny, evergreen, alternate leaves. The leaves occur clustered at the branch ends 1–3 inches long and have a network of red veins. Small, fragrant, white flowers are also found at the branch ends from the leaf axils, maturing into the small round, dark-purple fruits. These plants need both male and female plants to produce viable fruits (seed). The sex cannot be determined until the plant flowers in five to ten years. The male-female ratio is usually 3:1, and can be up to ten males to one female. The Hawaiians used the tough wood to make hand tools and in canoe building. I have no problem germinating Kāwa'u, though during the hot, dry summer months these plants declined in the NTBG nursery (at sea level), needing a cooler, moist location to thrive.

Entire Range: Indigenous; occurring in Tahiti, Marquesas, and Hawaiian Islands
Wild Habitat: Common in mesic to wet forests, sometimes in open bogs
Habit: Dioecious trees, occasionally shrubs
Mature Height: 15–45 ft (5–15 m)
Stem/Trunk: Tall, smooth bark, branching
Leaves: Dark green glossy above; reticulate below
Inflorescence/Flower: Dioecious, unisexual: small white flowers, calyx four-parted, corolla

six to ten parted; unisexual, cymose panicles 2–10 cm long, peduncles flattened, ovary superior (female) with staminodes present; male flowers with six to ten stamens and pistillode (Neal 1965; Judd et al. 1999)

Fruit: Purplish-black, globose

Seed: One to many (two to eighteen) seeded pyrenes as carpels, small, brownish-black seeds with abundant oily or proteinaceous endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruit when ripe and purplish-black in color. Keep the pulp soft in a plastic bag.
- Remove the pulp when it is soft as directed, or soak them in water for an hour also to soften the pulp.
- For best germination results, sow the small seeds right away.
- No pretreatment is necessary.
- Sow the seeds in shallow flats of 2–3 parts perlite to 1 part potting mix (3:1), and water the seeds in.
- Keep them moist in a shaded, covered area. In the wild, they grow in wetter locations on the islands.

GERMINATION (slow)

- Germination can take about two to six months. Give these small, slow-growing seedlings time to develop at least four true leaves before transplanting them into 2-inch pots.
- Use a moist, well-draining transplant mix with 2–3 parts cinder to 1 part peat moss or potting mix (3:1).
- Keep them in a partially shaded area for up to three months, and then move them into more sun.
- These slow-growing trees need to stay cool and moist with good ventilation for the best growth and development.

CUTTINGS

- To make cuttings, take semi-hardwood tip cuttings from well-matured current season's growth, from mid to late summer. Handle the cuttings as recommended.
- Remove the lower foliage from the base and reduce the top foliage by cutting the leaves in half. Then cut the base of the stem at a 45° angle.
- Apply rooting powder to the base of the cuttings, Hormex® Nos. 16, 30, or 45 are recommended.
- For best results, keep the cuttings in an intermittent mist in a greenhouse.
- It may take up to four to six months for roots to develop; they are slow-growing.

OUTPLANTING

- *Ilex* is ready for outplanting when it has outgrown a 1–2-gallon pot, which may take up to two years or more.
- To select an outplanting site, choose one with a cool, moist location with filtered light, because they can become sickly in hot, dry locations.
- Keep them watered when it is not raining for the first six months and until they are growing well (look for new growth).
- Monitor these plants closely; they are more sensitive than most.
- Remember, you will need at least five plants to have both male and female plants for pollination and seed production.
- Polymer is an option when outplanting, and can keep the plant from drying out.

PESTS

- Ants and weeds can infest the base of the plants, and they can both weaken the growth. Use the recommended ant and weed protocols to keep them under control.

A

ARALIACEAE

(GINSENG FAMILY)

GENUS:

Cheirodendron

HAWAIIAN NAMES:

ʻŌlapa; lapalapa

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
C. dominii	R	end (K) wet forests
C. fauriei	—	end (K) diverse mesic to wet forests
C. forbesii	—	end (K) wet forests
C. platyphyllum ssp. *kauiaense*	—	end (K) mesic to wet forests
C. platyphyllum ssp. *platyphyllum*	—	end (O) mesic to wet forests
C. trigynum ssp. *helleri*	—	end (K) mesic to wet forests
C. trigynum ssp. *trigynum*	—	end (HI exc. K, Ka) mesic to wet forests

Shade

Range
Hawaiian Endemic

Description
tree or shrub

Propagation
seeds and cuttings



***Cheirodendron trigynum* fruit – ʻōlapa — DB**

GENERAL DESCRIPTION

ʻŌlapa occurs as shrubs or trees, with large shiny leaflets in threes that flutter even in the lightest of winds. Any part of the plant smells like carrots when cut or crushed. The name is derived from the Greek cheiros, meaning "hand," and dendron, meaning "tree," referring to the three to five leaflets. The many small flowers cluster at branch ends slightly above the foliage. I have tried to grow this genus many times and found that the seeds are slow to sprout or grow and that it declines during the hot summer months. Since it occurs naturally in wet, cool environments, it may require these conditions to flourish in cultivation. Even at 3,000 ft elevation, the seedlings still germinated very slowly and grew weakly.

Entire Range: Hawaiian endemic
Wild Habitat: Diverse mesic forests to wet forests
Habit: Trees or shrubs
Mature Height: 6–50 ft (2–15 m)
Stem/Trunk: Branching, woody, smells like carrots when cut
Leaves: Palmately compound, opposite, leaflets three to five, margins entire or toothed;

mid-vein, margins, and petiole usually tinged purple; stipules absent

Inflorescence/Flower: Small, perfect flowers, in multiples of five, ovary inferior, in terminal, erect, oppositely branched panicles of umbellules; petals purple externally, greenish within

Fruit: Drupe, green ripening to dark purple, fleshy, globose, or laterally compressed, may be strongly ribbed when dry

Seed: Four to six flattened, blackish seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (difficult)

- To propagate by seed, first collect the fruits when they are ripe and dark purple in color. Keep the pulp soft in a plastic bag.
- Remove the pulp as recommended for medium-sized seeds.
- These seeds can be stored in the refrigerator for a few months, they do not store well in desiccation. For best germination results, sow them right away.
- Soak the seeds in tap water for one to four hours, discard the seeds that float, and air-dry the remaining seeds.
- Sow the seeds in a shallow pot of 2–3 parts perlite to 1 part potting mix (3:1).
- Then cover the seeds with ½ inch of seed mix, water the seeds in, then water every other day.
- Keep them in a covered, shaded, moist area, and apply a light solution of foliar feed for them monthly after the seeds have germinated.

GERMINATION (slow)

- It may take one to six months (even up to a year) for all viable seeds to sprout. The germination is very inconsistent; even at 3,000 ft elevation they still germinated very slowly, and grew weakly.
- These are slow-growing trees; wait until the seedlings have four true leaves before transplanting them.
- Transplant them into 3-inch-tall pots, in a moist, well-draining mix.
- Repot the plants every six months into larger, taller pots, and use new media.
- Keep them in a cool protected and shaded area. They are very sensitive to hot, dry locations.

CUTTINGS

- The plant supplying the cuttings has to be healthy and growing vigorously in order for the cuttings to root.
- Use material from hard to semi-hardwood cuttings that are taken in late spring to early summer. Handle them as recommended, and do not allow the material to dry out at any time.
- Use rooting powder Nos. 8 to 45, or try different strengths to see what works best for you and the environment you are growing them in.
- Keep the cuttings in a cool, covered, shaded area, ideally in a mist system if one is available.
- If these root at all, it may take six months. They are a slow-growing species, but are worth the extra care.

OUTPLANTING

- Your ʻōlapa will be ready for outplanting in two to three years, when the plant has grown twice the height of a 1 – 2-gallon pot.
- Choosing the outplanting site is important for this genus. They require cooler higher elevations with moist, well-draining soil and environment.
- Polymer applied to the soil as recommended can help keep the site moist for the plant.
- Prepare the planting hole as recommended, and be careful not to dig the hole too deep. This prevents the plant from sinking down after time, which can bury the lower trunk and cause the plant to die.
- Water weekly until the plant is growing healthily on its own, and then water when it is dry.

PESTS

- Weeds and ants often occur at the base of the tree and are common pests. They can weaken the plant, and the weeds can take up the much-needed moisture intended for the plant.

A

ARALIACEAE
(GINSENG FAMILY)

(Based on molecular data, the following genera *Munroidendron, Reynoldsia* & *Tetraplasandra* have merged into genus *Polyscias*. (Lowry & Plunkett 2010:74))

GENUS:
Polyscias (syn. *Munroidendron*)

HAWAIIAN NAME:
Pōkalakala (J.R. Porter 1972)

SPECIES	STATUS	HAWAIIAN RANGE
P. racemosum	E	end (K)

Partial Sun–Full Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Munroidendrum racemosum* fruits – Kaua'i — SP**

GENERAL DESCRIPTION

Pōkalakala is easier to grow and maintain in the landscape than the other genera within the Araliaceae family. In the wild, they only occur on Kaua'i in mesic forests. The pōkalakala has a straight trunk covered with smooth gray bark, and with large leaflets, five to nine per branch, that are downy white to brown underneath. The small, pale-yellow, bee loving flowers hang from the tree on long dangling unbranched paniculate racemes, as do the round, white, downy fruits that darken and soften when mature and contain four to six flattened dark seeds. If dry, the tree sheds most of its leaves in late summer and also when they are in bloom. I conducted an experiment with hundreds of these seeds from a cultivated tree at NTBG. I scarified the seeds, soaked them in hot and cold water, and did not use any pretreatments. I even sowed the seeds that floated after soaking, which are usually discarded. The seeds soaked in tap water for one hour had the highest germination results, which took three months. However, all of the treatments worked in time, and even some of the floaters germinated.

Entire Range: Endemic to Kaua'i, Hawai'i
Wild Habitat: Mesic forests
Habit: Tree, sparsely branched

Mature Height: 25 ft (7 m)

Stem/Trunk: Gray and smooth

Leaves: Pinnately compound, alternate, leaflets five to nine, coriaceous, upper surface glabrous, lower covered with a dense, yellowish-brown dried material, mar-gins entire, stipules absent



Polyscias racemosum —F&KS

Inflorescence/Flower: Flowers perfect, regular, with twelve to twenty pale yellow petals, stamens ten to fifteen, ovary inferior, twelve to fifteen carpellate; styles as many as carpels, twelve to fifteen stigmas; occur on a paniculate-racemose inflorescence

Fruit: Drupe, globose 8–12 mm long

Seed: Hard (pyrene), flattened, purplish-dark seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the pulpy fruits when they are soft and dark reddish-purple, and shedding from the tree.
- Remove the pulp as recommended for medium seeds. There are five flat seeds per fruit.
- It is best to start the seeds fresh, because they do not tolerate desiccated seed storage. However, the seeds can be refrigerated.
- The highest germination rate resulted from a one-hour soak in tap water. After soaking, air-dry the seeds for a few hours.
- Use a seed mix made up of 3 parts perlite to 1 part potting mix (3:1), and keep them in a shaded, covered area

GERMINATION

- It can take from one to six months for all viable seeds to sprout.
- Transplant the seedlings when they have at least two to four true leaves.
- Transplant them into tall 3 – 4-inch pots, giving the tree roots room to grow down for healthy development.
- Repot your plants every five to six months into taller pots, and use new media for healthy root development.

CUTTINGS

- I have tried making cuttings of pōkalakala; all attempts have failed to root.
- They are most successfully grown from seed, and you will end up with a healthier tree in the long run. Plants grown from seeds have better root systems to support the resulting large mature tree.

OUTPLANTING

- Pōkalakala will be ready for outplanting in one year or when it is twice as tall as a 2-gallon pot.
- Choose a site with filtered to full sun in well-draining soil, and amend the soil as recommended.
- Prepare a hole and plant as discussed, water weekly until established, then only water when it is very dry.
- Pōkalakala is not as sensitive as the other native Hawaiian genera in the Araliaceae family. They are easier to grow and maintain than *Cheirodendron* and ʻōhe ʻōhe, which both occur in higher, cooler elevations in the wild.
- Pōkalakala has good landscape potential for Kauaʻi, especially in lowland areas, due to its hardiness and ability to thrive in dry areas.

PESTS

- Ants and the insects they farm can be pests for pōkalakala. Use the recommended ant bait and also spray horticultural oil for controlling the insects.
- Red spider mites live on the underside of the leaves, turning them yellow; control as recommended.
- Two spotted leafhoppers on the underside of the leaves (causing spotted discoloration on the leaves), spray with horticultural oils.
- Hungry rats and snails occasionally eat the bark off the younger stem growth, control by using suitable baits.

A

ARALIACEAE

(GINSENG FAMILY)

GENUS:

Polyscias (syn. *Reynoldsia*)

HAWAIIAN NAMES:

'Ohe; 'ohe makai; 'ohe'ohe; 'ohe kukuluae'o; 'oheokai

SPECIES	STATUS	HAWAIIAN RANGE/ HABITAT
P. sandwicensis	R	end (HI exc. K, Ka) dry to mesic forests

Partial Sun – Full Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



P. sandwicensis **fruit – O'ahu — KRW**

GENERAL DESCRIPTION

'Ohe is a lowland tree with a straight stout trunk and a spreading crown. It has thick branches, and it is deciduous during the dry season, when it loses most of its leaves. The seven to eleven scalloped leaflets are bright green and glossy. Greenish-yellow fleshy flowers develop at the branch ends along branching spikes, giving way to round dark-purple ribbed fruits (drupes) that contain small, flat, dark seeds. Their growth habitats vary according to regional climate and soil conditions. 'Ohe is an attractive, easy tree to grow and maintain in the landscape if planted in drier locations with free-draining soil.

Entire Range: Hawaiian endemic

Wild Habitat: Dry to mesic forest

Habit: Tree, straight trunk, and spreading crown

Mature Height: 60–90 ft (20–30 m)

Stem/Trunk: Glabrous tree, soft wood, whitish, with prominent resin ducts

Leaves: Seasonally deciduous, pinnately compound, alternate, leaflets membranous, margins crenate to serrate

Inflorescence/Flower: Flowers perfect, petals greenish-yellow, fleshy, strongly recurved at anthesis, anthers dark yellow, actinomorphic (radially symmetrical), terminal, paniculate-racemose, glabrous, or sparsely pubescent; ovary eight to ten carpellate

Fruit: Drupes dark purple, globose, ribbed when dry, and laterally compressed

Seed: Smooth, hard (pyrenes) seeds, with a small embryo and fleshy endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the ripe fruit in the late fall, when they are dark purple, and keep them in a plastic bag to soften them.
- Remove the softened pulp as recommended; there are usually five (or more) flat seeds per fruit.
- These seeds can be stored in a desiccation chamber or at room temperature for up to five years with some loss of viability. Use fresh seeds for the best results.
- Soak seeds for twenty-four hours in tap water, and then air-dry the seeds.
- Sow in a mix made up of 3 parts perlite to 1 part potting mix (3:1); keep in a covered area to control the moisture.
- Only water every two days as these seeds are accustomed to drier environments.

GERMINATION

(fast-growing)

- Germination can take one to six months for all viable seeds to sprout. After they germinate, wait until at least four true leaves develop before repotting.
- Transplant into tall 3 – 4- inch pots to obtain healthy root growth.



Reynoldsia sandwicensis **seedling – NTBG nursery — PT**

- Choose a well-draining soil mix and allow it to dry between watering.
- Keep seedlings in the shade for two weeks, and then move them into more sunlight.
- Repot them after two to three months initially (fast-growing), then repot them after six to seven months. Do not allow the roots to become root-bound, as this will damage their structure and health later on.

CUTTINGS

- It is best to grow 'ohe makai from seed for strong, healthy root growth.

OUTPLANTING

- 'Ohe makai will be ready for outplanting after one to two years, when tree has grown twice as tall as a 1 – 2-gallon pot.
- Choose a location in full sun that has well-draining soil, and amend the soil as recommended.
- Water the freshly planted tree for the first month, then only water during droughts, or when the plant is stressed. Too much soil moisture can kill this tree as it occurs in dry forests in the wild.
- Plant the tree at the same depth as it was in the pot. After planting, watch the planting site over time; the soil may sink down into the hole and cover the bottom portion of the trunk. If this happens, be sure to keep the lower trunk from being below the soil surface.

PESTS

- Control the ants and weeds from the base of the tree. To inhibit ants from farming harmful sucking insects, bait for ants and spray horticultural oils for insects. To prevent weed-eater damage, keep the area weeded; weeds will compete with your tree for water.

A

ARALIACEAE

(GINSENG FAMILY)

GENUS:

Polyscias (syn. *Tetraplasandra*)

HAWAIIAN NAME:

'Ohe'ohe

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. gymnocarpa	E	end (O) mesic to wet forests
P. kavaiensis	AS	end (K, O, L, M, H) mesic to wet forests

HAWAIIAN NAME:

'Ohe

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. bisattenuata		end (K) mesic to wet forests
P. flynnii	R	end (K) wet forests
P. hawaiensis	AS	end (Mo, L, M, H) mesic to wet forests

HAWAIIAN NAME:

'Ohe mauka

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. oahuensis	AS	end (HI exc. Ni, Ka) mesic to wet forests

HAWAIIAN NAME:

—

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. lydgatei		end (O) mesic to wet forests
P. waialealae		AS end (K) mesic to wet forests

HAWAIIAN NAME:

'Ohe kiko'olā

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. waineae	AS	end (K) wet forests

Shady

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Tetraplasandra* sp. flowers — SP**

GENERAL DESCRIPTION

'Ohe 'ohe are medium to large upright trees, with six to eight pairs of leaflets, which are sometimes hairy underneath. The tiny fleshy flowers develop along branching spikes at the branch ends, as do the many juicy dark-purple ribbed fruits. The 'ohe 'ohe arrived to the islands via birds, Kaua'i and O'ahu species fruits have evolved becoming quite a bit larger losing their dispersal abilities (Carlquist et al 1972). I feel that these trees are uniquely beautiful and are worth the extra care they need. Should be used more in higher elevation landscape and conservation projects. This is a slow growing but fairly hardy tree if the roots have not been damaged from being root-bound at any time.

Entire Range: Hawaiian endemic
Wild Habitat: Mesic to wet forests
Habit: Trees or shrubs
Mature Height: 8–80 ft (2.5–25 m)
Stem/Trunk: Vertical and branching
Leaves: Pinnately compound, alternate, five to twenty-one leaflets, coriaceous, glabrous upper surface, and lower surface glabrous to pubescent, margins entire
Inflorescence/Flower: Flowers perfect, actinomorphic (radially symmetrical), petals five to nine, stamens as many as petals and alternate to them, two to twelve carpels and styles as many as carpels, inferior ovary, which can become half or fully superior by expansion of floral disk, terminal, compound-umbellate, or racemose-umbellate inflorescences
Fruit: Drupe, globose, rounded, or angular, laterally compressed
Seed: Seeds papery, flat and shaped and arranged like sections in an orange, but smaller (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are ripe and purplish and shedding from the tree; keep the pulp soft in a plastic bag.
- Remove the pulp as recommended for medium-sized seeds.
- These seeds can be stored in the refrigerator for a few months; they do not store well in desiccation. For best germination results, sow them right away after cleaning.
- Soak the seeds in tap water for 1–4 hours, discard the seeds that float, and air-dry the remaining seeds.
- Sow the seeds in a shallow flat of 3 parts perlite to 1 part potting mix (3:1).
- Cover the seeds with ½ inch of recommended seed mix, water the seeds in, then water every other day.
- Keep them in a covered, shaded, moist area, and apply a light solution of foliar feed monthly after the seeds have germinated.



P. bisattenuata **– M.Clark USFWS**

GERMINATION (slow)

- It may take one to six months for all viable seeds to sprout; the germination is very inconsistent.
- These are slow-growing trees; wait until the seedlings have four true leaves before transplanting them.
- Transplant them into 3-inch-tall pots, in a moist, well-draining mix of black cinder and potting mix.
- Repot the plants every six months into larger, taller pots, for healthy root growth, do not allow the roots to become root bound at any time.
- Keep them in a cool, protected, shaded area. They are very sensitive to hot, dry locations and wind.

OUTPLANTING

- Your *Polyscias* will be ready for outplanting in one to two years, when the plant has outgrown a 1- to 2-gallon pot.
- Choosing the outplanting site is important for this genus. They require cooler, shady environment with moist, well-draining soil.
- Polymer applied to the outplant hole as recommended can help keep the soil moist for the plant.
- Prepare the planting hole as recommended, and be careful not to dig the hole too deep. This prevents the plant from sinking down after time, which can bury the lower trunk and cause the tree to die.
- Water weekly until the tree is growing healthy on its own, and then water when it is dry until it is established.

A

ARECACEAE

(PALM FAMILY)

GENUS: ***Pritchardia***

HAWAIIAN NAME: **Loulu**

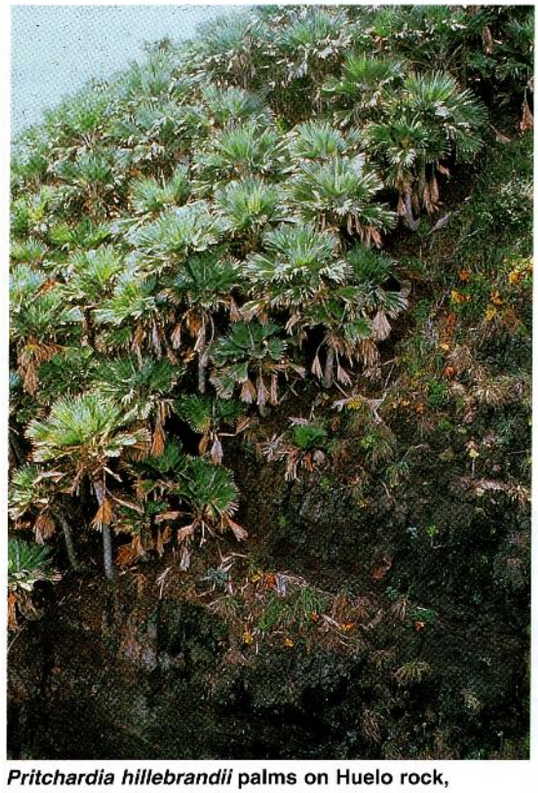
Sun Requirements
Species specific

Range
Hawaiian Endemic

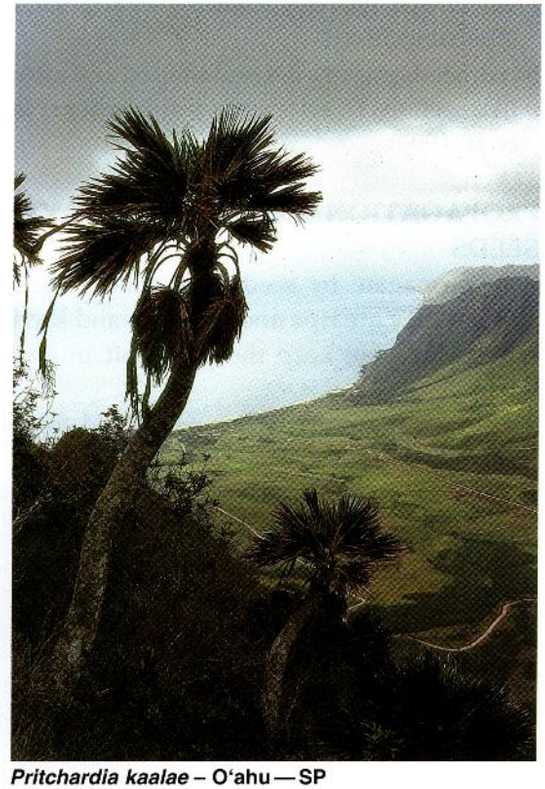
Description
palm tree

Propagation
seeds

SPECIES	STATUS	HAWAIIAN RANGE
P. arecina	AS	end (M)
P. bakeri		end (O)
P. beccariana	AS	end (H)
P. flynnii		end (K)
P. forbesiana	R	end (Mo, M)
P. glabrata (syn. *lanaiensis*)	V	end (L, M)
P. gordonii		end (H)
P. hardyi	R	end (K)
P. hillebrandii	AS	end (Mo)
P. kaalae	E	end (O)
P. lanigera	R	end (H)
P. lowreyana	E	end (O, Mo)
P. maideniana (syn. *affinis*)		end (H)
P. martii	AS	end (O)
P. minor	AS	end (K)
P. munroi	E	end (Mo, M)
P. napaliensis (syn. *limahuliensis*)	E	end (K)
P. perlmanii	E	end (K)
P. remota (syn. *aymer-robinsonii*)	E	end (Ni)
P. schattaueri	E	end (H)
P. viscosa	E	end (K)
P. waialealeana	R	end (K)
P. woodii		end (M)



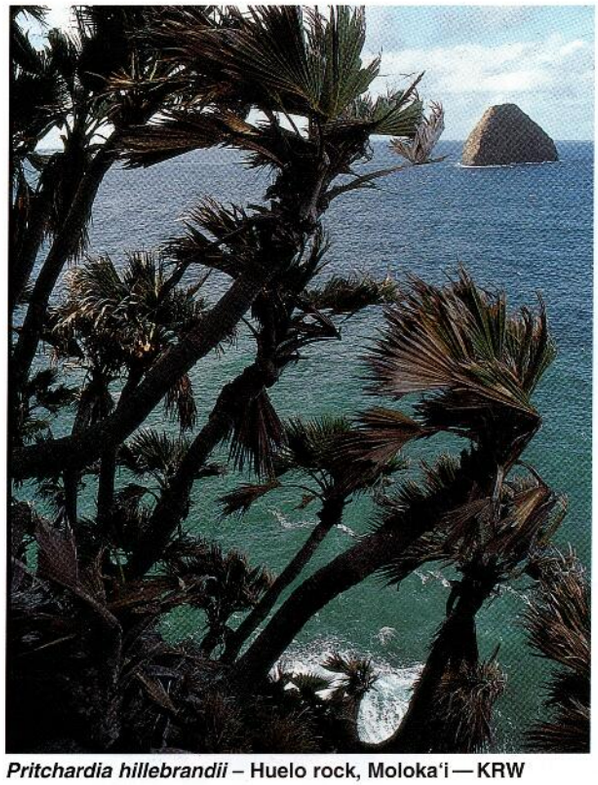
***Pritchardia hillebrandii* palms on Huelo rock, Moloka'i — KRW**



***Pritchardia kaalae* – O'ahu — SP**

GENERAL DESCRIPTION

Pritchardia is the only palm genus native to Hawai'i. They are monocots, solitary, unarmed medium to tall trees with fan-shaped leaves. Their flowers appear in an attractive inflorescence, which develops green fruit over several months, turning blackish when mature. *Pritchardia* are very attractive in the landscape; *P. hillebrandii* and *P. remota* will thrive in coastal plantings. I have found that sometimes the seedlings sprout as short-lived albinos,



Pritchardia hillebrandii **– Huelo rock, Moloka'i — KRW**



Pritchardia **sp. fruits – Maui — DR**

all white, living up to three months before dying from lack of chlorophyll. Five new species have been added to the list and four submerged with other species, *affinis, aymer-robinsonii, limahuliensis, lanaiensis*

Entire Range: Hawaiian endemic

Wild Habitat: Low land habitats to mesic diverse forests

Habit: Solitary, erect palm, unarmed, with a crown of palmate leaves

Mature Height: 30–120 ft (10–40 m)

Stem/Trunk: Solitary, longitudinally grooved, smooth, fibrous

Leaves: Costapalmate with petioles of various lengths

Inflorescence/Flower: Perfect flowers in multiples of three, pale white to yellowish, superior ovary, fragrant of-ten attracting honeybees, borne on branching, complex, interfoliar inflorescences



Pritchardia glabrata **flowers – Maui — KRW**

Fruit: The fruits are a drupe, green and fibrous ripening to dark purplish-black

Seed: There is a single seed per fruit, hard endocarp and seed coat, with a white, homogenous, endosperm. (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- It is important to wait until the fruit is ripe and turns brown to black in color before collecting. Fruits collected green usually are not fully developed, having thin seed coats (a covering, that protects the embryo); these thin seeds coats will crack open during cleaning, exposing the fragile embryo to disease.
- Keep the pulp soft in a plastic bag; this also helps to ripen them.
- Remove the pulp by hand, or use a pocketknife.
- Soak the seeds either before or after cleaning for twenty-four hours in tap water, then air-dry them.

- Optional: soak in a weak bleach solution (1 tsp. of bleach to 1 gal. water) or fungicide (follow directions on label) for five to ten minutes; this helps to prevent fungal attack.
- Start palm seeds fresh. They do not store well, and lose their viability quickly when desiccated; however they can be refrigerated for a few months.
- The appropriate seed mix depends on where the palm has evolved. For wetter environments (needed by, for example, *P. waialealeana* and *P. viscosa*) sow in moist sphagnum moss or cleaned black cinder and keep them in a mist system that is turned off at night.
- Use a potting mix made up of 3 parts perlite to 1 part potting mix (3:1), which works well for the other species; cover seeds with 1–2 inches of seed mix, depending on the seed size.
- Keep seed flats in a covered, shaded area, and water them every other day.
- Protect the seeds from rats by placing a wire screen over the flat, as they will try to find and eat the tasty endosperm.







Top to Bottom, Clockwise:

***Pritchardia* fruits soaking before removing pulp, NTBG nursery**

Cleaning palm seeds

Cleaned palm seeds, NTBG nursery

—All images by MC

GERMINATION

- Most loulu germinate in one to two months; seeds that were collected immature can take up to six months to sprout, if they sprout at all.
- Transplant as the seedlings germinate into 4 – 6-inch pots, to accommodate their stiff taproots.
- Choose a well-draining transplant mix, as recommended.
- Gently remove the seedlings by the leaves, not the roots, which are easily broken.
- The seed stays attached to the seedlings; bury all the roots up to the crown and seed.
- Water them in, and keep the newly transplanted seedlings in a shaded area, elevated off the ground and away from toads (which like to nestle in the pots, displacing the seeds and seedlings) and other pests.
- In a few months move them into more sun to help harden them off for outplanting.
- Repot your palms into taller pots and new soil every six months or so, do not allow the roots to



***Pritchardia limahuliensis* seedlings – NTBG nursery — KLR**

become thoroughly root-bound. Unhealthy roots make for an unhealthy plant in the long run; tall citrus pots work well for larger palms.

OUTPLANTING

- When the palm has outgrown a 2-gallon pot in two years or so, it is ready for outplanting.
- Amend the hole and soil as recommended. Loulu palms found in higher elevation do best in well-draining soils in partial shade; the lower elevation palms do better in full sun, and well-draining soil.



***Pritchardia viscose* – NTBG nursery — KLR**

FULL SUN SPECIES

- *P. hillebrandii*
- *P. lowreyana*
- *P. maideniana*
- *P. remota*
- *P. schattaueri*

PARTIAL SHADE SPECIES

- *P. arecina*
- *P. bakeri*
- *P. beccariana*
- *P. flynnii*
- *P. forbesiana*
- *P. glabrata*
- *P. gordonii*
- *P. hardyi*
- *P. kaalae*
- *P. lanigera*
- *P. martii*
- *P. minor*
- *P. munroi*
- *P. napaliensis*
- *P. perlmanii*
- *P. viscosa*
- *P. waialealeana*
- *P. woodii*

FERTILIZE

- Use a balanced fertilizer such as 8-8-8 NPK for transplanted seedlings
- Use 14-14-14 NPK for older plants one year and up.
- Apply every four to six months to keep the palm healthy; one indication of stress is the leaves yellowing.

PESTS

- Leafrollers are a native insect that cause holes and rips in the leaves as they eat; they then roll up in the leaves to pupate, not killing the palm, but making the plant look ragged. Use horticultural oil for control.
- Sugarcane borers will bore a hole in the side of the trunk of the palm and kill it as the grubs eat out the pith. The grubs will then pupate in the trunk, the palm may look healthy, but it can be dead within a week. Use a systemic pesticide (for example, a soil drench).
- Red spider mites on the underside of a leaf will cause the leaf to yellow; to treat, spray with a horticultural oil.
- Ants living at the base of the tree will farm a number of insects; control as recommended.
- Rats love to eat *Pritchardia* seeds, seedlings, and petioles (leaf stalk); look for claw marks and half-eaten seeds, or seedlings with their leaves gone; monocots have only one growing tip, which when removed will cause the plant to die. Set traps or cover the seed flats with small mesh wire.

A

ASTERACEAE
(SUNFLOWER FAMILY)

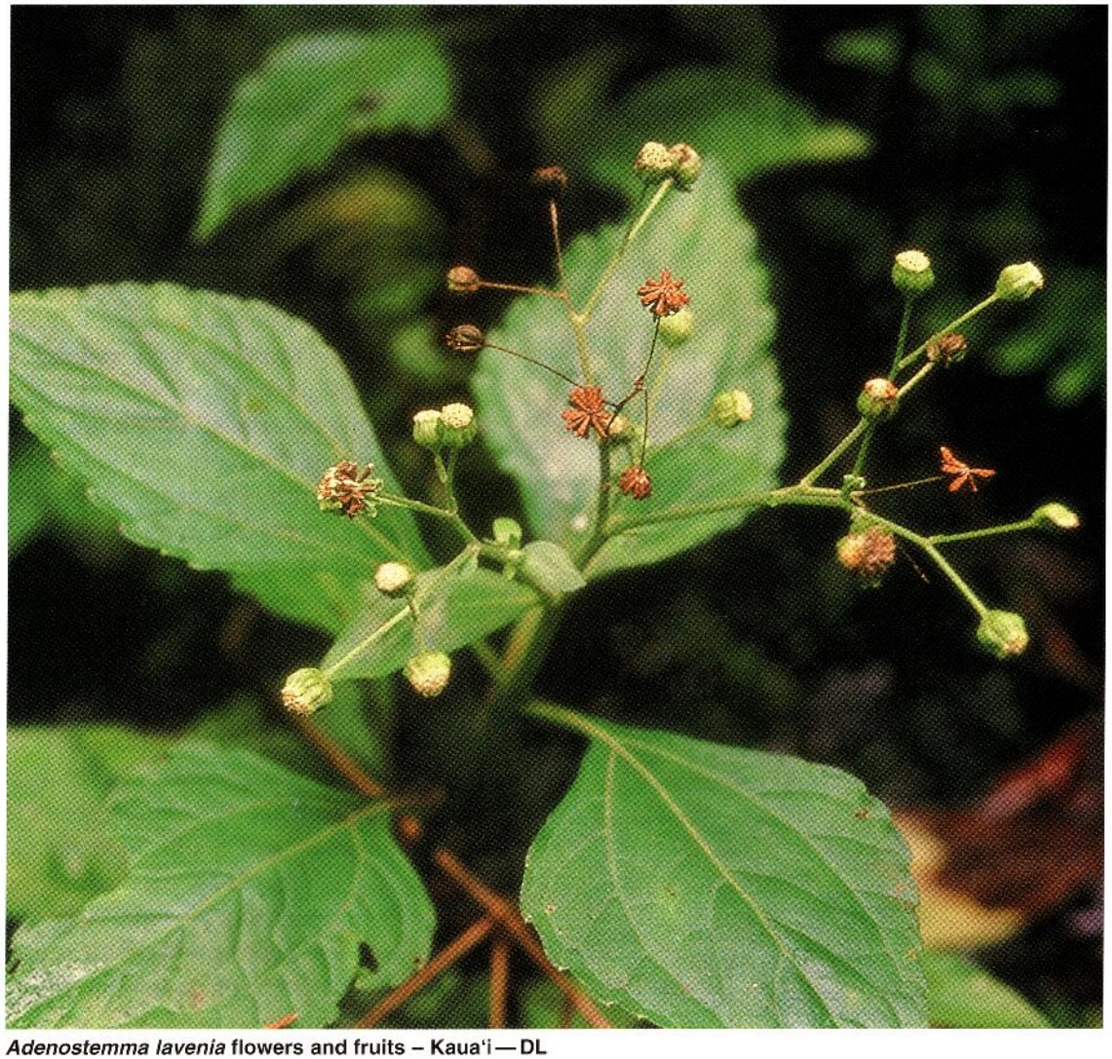
GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Adenostemma	**Kāmanamana**	*A. viscosum*	—	ind (HI exc. Ni, Ka)

Shady

Range
Indigenous

Description
perennial herb

Propagation
seeds



***Adenostemma lavenia* flowers and fruits – Kaua'i — DL**

GENERAL DESCRIPTION

A weedy perennial herb 1–2 feet high; stems are covered with downy purplish hairs, occurring naturally in shady mesic valleys to wet forest. The toothed, opposite, diamond-shaped leaves are 3–8 inches long, and the flower heads develop at branch ends above the foliage, as do the dry brown fruits (achenes). The Hawaiians used the leaves in a tincture to treat fever (Wagner et al. 1990).

Entire Range: Indigenous: widespread from China to Malaysia, Australia, tropical Africa, Polynesia, and Micronesia; in Hawai'i uncommon in mesic valleys or wet forests, usually in shaded areas and along streams, disturbed areas along trails, and taro patches, all main Hawaiian Islands except Ni'ihau and Kaho'olawe (Wagner et al. 1990)

Wild Habitat: Along streams, disturbed areas along trails, and taro patches

Habit: Perennial herbs

Mature Height: 20–40 inches. (5–10 dm)

Stem/Trunk: Glandular pubescent with purplish hairs

Leaves: Ovate to rhombic, 5–15 cm long, 1.5–7 cm wide, glabrous, margins coarsely serrate with gland-tipped teeth, base cuneate to attenuate

Inflorescence/Flower: Flower heads about 5 mm in diameter, disk corollas white, 3.5 mm long

Fruit: Achenes brown, warty, 4–5 mm long

Seed: One small, dry seed per achene (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect fruits (achenes) when brown and dry; keep them in a dry paper bag.
- Clean them as recommended for dry seeds.
- Surface sow the tiny seeds on a mix of 2 parts perlite to 1 part potting mix (2:1), water in the seeds.
- Keep them in a covered, shaded area, and water every other day.
- Seeds do tolerate desiccation, or they can be stored in refrigeration or at room temperature.

GERMINATION

- Germination of all of the viable seeds may take two weeks to three months .
- After two to four true leaves appear, transplant them into 4-inch pots.
- Use a moist, well-draining mix as recommended; amend with cinder.
- Keep potted seedlings in shaded, moist area.
- Repot them in two to four months into larger pots.
- Move the seedlings to filtered sunlight after a few weeks.

OUTPLANTING (fast-growing)

- Your plants will outgrow a 4-inch to 1-gallon pot in about six months.
- Choose a shady moist area in filtered sun.
- Prepare a planting site by amending a hole as recommended with cinder.
- Then water often until the plant is growing well, as indicated by new growth; after that, water during times of drought.

PESTS

- Control ants and weeds from the base of the plant using the ant protocol described.

A

ASTERACEAE
(SUNFLOWER FAMILY)

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds

GENUS:
Argyroxiphium

HAWAIIAN NAME:
'Eke silversword

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. calliginis	R	end (M) bogs

COMMON NAME:
Greensword

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. grayanum	R	end (M) bogs to wet forests
A. virescens	Ex	end (M) mesic to wet forests

HAWAIIAN NAME:
Ka'u silversword

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. kauaense	E	end (H) bogs to wet forests

HAWAIIAN NAMES:
Hinahina; 'āhinahina

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. sandwicense ssp. *macrocephalum*	E	end (M) alpine deserts
A. sandwicense ssp. *sandwicense*		end (H) alpine deserts



***Argyroxiphium grayanum* flowers – Maui — KRW**



***Argyroxiphium sandwicense* ssp. *macrocephalum* collecting seeds – Maui — SP**

GENERAL DESCRIPTION

Argyroxiphium has numerous whorled leaves that are long, narrow, and pointed; they grow into a round rosette shrub. Some species have branching stems that grow without rooting along the ground. When these plants are ready to bloom, a single, fleshy stem 6 feet or so in height rises from the middle of the plant. The long stalk abounds with flower heads (yellow to purplish, depending on species). The long, dry fruits (achenes) are darkish black when mature.

The name "silversword" is derived from the Greek word *argyros*, meaning "silver" and *xiphos*, meaning "sword," referring to the spiky silver leaves. These plants are found only on Maui and Hawai'i at altitudes of 6,000–12,250 feet, growing in rocks, porous dry soil, or in cinder. They are true alpine plants, which reach maturity in about 10–15 years, and after flowering they die (monocarpic).

At the NTBG nursery, which is 15 feet above sea level, I was able to germinate seeds, but the seedlings were short-lived and died when the temperatures increased in the nursery during the hot summer months. These plants would thrive in cultivation in lower elevations if grown in colder environments or a cool-room.

Entire Range: Hawaiian endemic
Wild Habitat: Mesic to wet forests, bogs, and alpine deserts
Habit: Erect to spreading, rosette shrubs
Mature Height: 4 inches to 5 ft (10 cm to 1.5 m) flowering stem
Stem/Trunk: Erect to spreading, unbranched to somewhat branched, polycarpic to monocarpic rosette shrubs, leaf scars may be prominent
Leaves: Green to brilliantly silver, simple, spirally arranged or in whorls of five to seven per node, narrowly sword-shaped or sword-shaped-lanceolate
Inflorescence/Flower: Heads 10–600 in elongate, extremely viscid-glandular, racemose or paniculate inflorescences, radiate or rarely discoid; disk florets
Fruit: Achenes 4–15 mm long, straight to somewhat arcuate, glabrous
Seed: Small, dry with one seed per achene (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect fruits (achenes) when mature, dried and blackish and shedding from the plant; keep them dry in a paper bag.
- Clean them as recommended for dry seeds.
- These seeds can be stored for up to seven years in desiccation, but will lose some viability.
- No pretreatments are needed, as the seed coats are thin.
- Surface sow the seeds on a leveled mix made up of 3 parts perlite to 1 part potting mix (3:1) then water the seeds in.
- Use a mix of 2 parts black cinder to 1 part potting mix (2:1) for *A. sandwicense*.
- Keep them in a dry, cool environment for best results; a lighted air-conditioned room works well.
- Water them every other day; foliar feed them with a weak solution once the seedlings sprout.

GERMINATION

- You may discover a poor germination rate, which may be due to inbreeding.
- It may take one to six months for all viable seeds to sprout.
- Wait until the seedlings have at least four true leaves.
- Very gently remove the seedling from the mix, and handle by the leaves.
- Use a well-draining transplant mix amended with cinder.
- It is important that these seedlings are kept cool, dry, and in a shaded area.
- Be careful that high humidity and moisture does not cause damping-off; using a well-draining mix will help prevent this.
- Move the seedlings into more sun in a month or so; this will help them to harden off.

OUTPLANTING

- Outplanting is indicated when within six to twelve months the plants have outgrown a pot ranging in size from 4 inches to 1 gallon.
- For the silverswords with gray leaves, such as ʻāhinahina, which means "very gray," choose a site in full sun, cool, and on the dry side; they thrive at altitudes of 6,000 feet or higher.
- These silverswords store water in their leaves in a gel substance, so this plant has evolved to withstand drought. Consequently, overwatering or long periods of rain in poor-draining soil can be harmful to these plants.
- The greensword's leaves lack the silver-gray hairs, have less gel substance to retain water, and can handle more moisture and shade, but still need cool temperatures and well-draining soil.
- Dig and prepare a hole as recommended with cinder.
- Water them weekly for about a month, and then only water them during times of prolonged drought.
- Monitor your plants closely; they are well worth the extra care.

PESTS

- Ants can be a problem; they can farm insects on the plant. Control ants as recommended.
- In the wild, goats and vandalism by humans are the major threats.

A

ASTERACEAE
(SUNFLOWER FAMILY)

GENUS:
Artemisia

COMMON NAME:
Wormwood

HAWAIIAN NAMES:
ʻĀhinahina; hinahina

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. australis	—	end (Le, HI) cliff faces West side
A. kauaiensis	—	end (K) inland cliff faces
A. mauiensis	—	end (M) subalpine shrubland

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
perennial herb to subshrub

Propagation
seeds and cuttings



Artemisia mauiensis **potted plant – Kauaʻi — KJ**

GENERAL DESCRIPTION

Hawaiian *Artemisia* are small perennial herbs to subshrubs with deeply cut silver-gray leaflets, 2–4 feet height and diameter. The flower heads, and later dry achenes (fruits), form on small branching spikes at branch ends among the foliage. *A. australis* leaves have a strong, sage-type fragrance and I have heard they were used by the Hawaiians to keep insects from eating the feather clocks in koa calabashes. *Artemisia* is easier to grow and maintain in the landscape than the silversword and greensword; it is a very attractive small shrub with its gray, lacy foliage. Outplanting them into a dry cinder garden with other plants, such as trees (wiliwili), shrubs (*ʻaʻaliʻi*) and ground covers (ʻilima) creates an attractive native garden.

Entire Range: Hawaiian endemic
Wild Habitat: Cliff faces, inland cliff faces, and subalpine shrubland
Habit: Perennial herbs or subshrubs, strongly aromatic to nearly odorless
Mature Height: 2–4 ft (0.75–1.25 m)
Stem/Trunk: Stems branching alternately, herbaceous to woody, glabrous to densely pubescent
Leaves: Green to grayish green on upper surface, lower surface gray or white, simple, alternate, glabrous to densely pubescent, usually amply dotted with resinous glands, entire to coarsely lobed or finely pinnately divided

Inflorescence/Flower: Disk florets, perfect or with marginal pistillate flowers, corolla pale yellow, tubular, five-toothed, less than 2 mm long; anthers longer than the filaments

Fruit: Achenes pale brown, to black, or nearly white, obovoid, slightly flattened, 0.3–1 mm long dotted with resinous glands, sparsely pubescent or completely glabrous

Seed: Very small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect achenes when they are dry and brownish in color.
- Keep them in a dry paper bag until cleaned.
- Separate the small, dry seeds from the debris as recommended.
- The seeds can be desiccated or stored dry at room temperature or in the refrigerator.
- No pretreatments are necessary; surface sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1).
- Water the seeds in, then water them every other day and keep them in a covered, protected area.



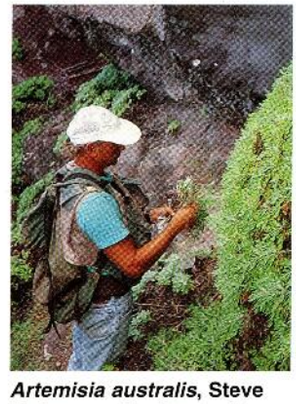
***Artemisia mauiensis* seed heads — PT**



***A. mauiensis* seeds — KLR**

GERMINATION

- It may take two weeks to three months for all viable seeds to sprout.
- Wait until the seedlings have four to six true leaves before potting into 2-inch pots.
- A cinder soil or well-draining mix is recommended.
- Keep your seedlings in the shade for two weeks, then move them into full sun to help harden them off.
- Water them every other day.



***Artemisia australis*, Steve Perlman collecting cuttings – Maui — KRW**

CUTTINGS

- In spring to early summer, take semi-hardwood or soft-wood tip cuttings 3–4 inches long in the morning hours: not when the plant is blooming or in seed.
- Remove all the lower foliage from the base and reduce the top foliage by cutting the leaves in half.
- Recut bottom, then apply rooting powder No. 1 or none at all, both work well.
- Moisten a mix of 3 parts perlite to 1 part vermiculite (3:1) or use a mix of 3 parts perlite or fine black cinder to 1 part potting mix (3:1) then water them in lightly.
- Rooting will take place in two to three months and will be accompanied by new foliage growth.
- Transplant your rooted cuttings into a well-draining mix, as recommended.
- Keep them in the shade for two weeks, then move them into full sun to help harden them off.

OUTPLANTING

- Your ʻāhinahina will be ready for outplanting in six months, or when they outgrow a 6-inch pot.
- Choose a location with full to partial sun, and with a well-draining soil.
- Water them for about the first month, and then water them during times of prolonged drought.
- When *Artemisia* is in bloom and/or in seed the plant looks ragged. To prevent this, trim off the flowers before seeding.

PESTS

- Ants are the most common problem because they farm scales and mealybugs; use ant protocol to keep them under control.

A

ASTERACEAE
(SUNFLOWER FAMILY)

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
erect perennial or annual herb

Propagation
seeds and cuttings

GENUS:
Bidens

HAWAIIAN NAME:
Ko'oko'olau; Ko'olau

SPECIES	STATUS	HAWAIIAN RANGE
B. amplectens	R	end (O)
B. asymmetrica	AS	end (O)
B. campylotheca	R/V	end (K, O, L, H)
B. cervicata	AS	end (Ni, K, O)
B. conjuncta	R	end (M)
B. cosmoides	V	end (K)
B. forbesii	AS	end (K)
B. hawaiensis	AS	end (H)
B. hillebrandiana	AS/V	end (Mo, M, H)
B. macrocarpa	—	end (O)
B. mauiensis	AS	end (L, M, Ka)
B. menziesii	AS	end (H, Mo, M)
B. micrantha	E/V	end (L, ,M, H)
B. molokaiensis	V	end (O, Mo)
B. populifolia	R	end (O)
B. sandvicensis	R	end (K, O)
B. torta	—	end (O)
B. valida	AS	end (K)
B. wiebkei	E	end (Mo)

Not shown here, fourteen new endemic subspecies have been listed.



***Bidens macrocarpa* flowers — KRW**

GENERAL DESCRIPTION

Erect short-lived perennial or annual herbs, very adaptable. The common weed *Bidens pilosa* (Spanish needle) probably looked much like its ancestor, whose fruit arrived hooked on the feathers of marine birds, but since then the native species have lost this dispersal mechanism. The seeds can spread and become weedy if outplanted in your yard, which is a good thing if you are using the leaves for tea. Ko'oko'olau leaves are used in a healing tea for diabetes (Levon Ohai 2000).

Entire Range: Hawaiian endemic

Wild Habitat: Summit ridges, cliffs, mesic forests, diverse mesic forests, windward coasts, coastal bluffs and cliffs, slopes, subalpine woodland to wet forest, bogs, lithified sand dunes, shrubland and dry slopes, and disturbed areas

Habit: Adaptable erect perennial or annual herb

Mature Height: 0.3–13 ft (0.1–4.0 m)

Stem/Trunk: Erect, decumbent, scandent (climbing), or suffrutescent (a perennial plant that is somewhat woody at the base) annual or perennial herb

Leaves: Simple, serrate or pinnately to tripinnately compound, opposite, pubescent or glabrous

Inflorescence/Flower: Heads solitary on long peduncles or in simple to compound cymes terminating the main stem and lateral branches, or only on lateral branches, radiate or discoid; rays yellow, white, orange, or red; disk florets perfect or pistillate, corollas yellow or orange, five-lobed

Fruit: Achenes obovate (inversely egg-shaped)-oblong, cuneate (wedge-shaped), or linear, obcompressed, curved, twisted, or coiled, occasionally with lateral wings, setose (covered with bristles) or glabrous (without hairs or glands)

Seed: The seeds are small and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (very easy)



***Bidens wiebkei* seed heads—SP**

- To propagate by seed, first collect fruits (achenes) when dry and brownish-black, and keep them dry by storing them in a paper bag.
- Clean the dry seeds and separate them from debris; viable seeds have a slight thickness to them when squeezed between the fingers.
- No pretreatments are needed; surface sow the thin seeds in a leveled mix of 3 parts perlite to 1 part potting mix (3:1).
- Water the seeds in, and then water them every other day.
- Keep them in a protected, shaded area.

GERMINATION (fast)

- If the seeds are viable, wait one week to two months to allow all of them to sprout.
- Transplant them into 4-inch pots after four true leaves develop.
- These plants are fast growing; keep them in the shade for two weeks, then move them to partial shade to full sun to help them acclimate.

CUTTINGS (easy)

- Collect softwood tip cuttings 3–4 inches long, with at least three nodes, in the morning hours. It is best if they are taken in the spring or summer months. If plants are stressed or flowering, they will have a lower rooting percentage.
- Remove the lower foliage and cut the top foliage in half, to reduce moisture loss.
- Start cuttings as soon as possible, or store them in the refrigerator in a sealed plastic bag to hold in the moisture.
- Keep the cuttings moist at all times and out of full sun.
- Use a shallow flat of 3 parts perlite to 1 part potting mix (3:1) or 3 parts perlite to 1 part vermiculite (3:1).
- No rooting powders are necessary; insert at least one of the bottom nodes into the potting mix.
- Water the cuttings in, and then water them every other day.
- Keep them in a shaded, covered area.
- Cuttings will root in about two months. Once rooted, carefully remove them and repot into 4-inch pots.
- Water them in, keep them in the shade for two weeks, and then move them to more sun.

OUTPLANTING

- Your cuttings and seedlings may be ready for outplanting in four to six months.
- Choose a site in full to filtered sun (species specific), and out of strong wind.
- Amend the planting holes as recommended for good drainage.
- Some of the more common species can become weedy in a landscape setting, which is a good thing if you're using the leaves for tea.

PESTS

- Pests may include red spider mites, which hide on the undersides of leaves, causing leaf yellowing. To control them, apply a spray of horticultural oil.
- Ants, mealybugs, and scales can also attack *Bidens*. Treat them with the recommended ant bait and a scale and mealybug pest control.

A

ASTERACEAE
(SUNFLOWER FAMILY)

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds and cuttings

GENUS:
Dubautia

HAWAIIAN NAMES:
Koholāpehu; na'ena'e; kūpaoa

There are now thirty seven endemic species found on all the main islands

SPECIES	STATUS	HAWAIIAN RANGE
D. arborea	R	end (H)
D. *carrii*		end (Mo)
D. ciliolata ssp. *ciliolata*	—	end (H)
D. ciliolata ssp. *glutinosa*	—	end (H)
D. *hanaulaensis*		end (M)
D. herbstobatae	E	end (O)
D. imbricata ssp. *acronaea*	—	end (K)
D. imbricata ssp. *imbricate*	R	end (K)
D. kalalauensis		end (K)
D. kenwoodii		end (K)
D. knudsenii ssp. *filiformis*		end (K)
D. knudsenii ssp. *knudsenii*		end (K)
D. knudsenii ssp. *nagatae*	R	end (K)
D. laevigata	AS	end (K)
D. latifolia	E	end (K)
D. laxa ssp. *bryanii*		end (O)
D. laxa ssp. *hirsute*		end (K, O, L)
D. laxa ssp. *laxa*	AS	end (K, O, Mo, H)
D. laxa ssp. *pseudoplantaginea*		end (O)
D. linearis ssp. *hillebrandii*	AS	end (H)
D. linearis ssp. *linearis*		end (L, M)
D. menziesii	—	end (M)
D. microcephala	R	end (K)
D. paleata	AS	end (K)
D. pauciflorula	E	end (K)
D. plantaginea spp. humilis	R	end (M)
D. plantaginea spp. magnifolia		end (K)
D. plantaginea spp. plantaginea		end (O, Mo, L, M, H)
D. platyphylla	R	end (M)
D. raillardioides	AS	end (K)
D. reticulata	R	end (M)
D. scabra ssp. *leiophylla*		end (Mo, M, L, H)
D. scabra ssp. *scabra*		end (M, H)
D. sherffiana	V	end (O)
D. syndetica		end (K)
D. waialealae	R	end (K)
D. waianapanapaensis (syn: *D. doosa*)		end (M)



***Dubautia plantaginea* ssp. *humile* flowers – Maui — SP**

GENERAL DESCRIPTION

Dubautia can grow into small trees or small to large shrubs. Narrow leaves, 1–8 inches long, opposite, alternate, or in threes. The numerous flower heads are clustered at branch ends. Most likely reaching the islands via bird feathers; for short distances the dry achenes (fruits) are wind dispersed, which is the reason this genus is so widespread. My experience indicates that some of the endangered species have seeds with low viability, which may be due to degraded habitats and inbreeding depression.

Entire Range: Hawaiian endemic

Wild Habitat: Summit bogs, subalpine shrubland, alpine deserts, dry shrubland, diverse mesic forests, mesic forests, wet forests, recent lava flow areas

Habit: Scandent subshrubs, shrubs, trees, or lianas

Mature Height: 0.3–26 ft (1 dm to 8 m)

Stem/Trunk: Stems well developed, often highly branched

Leaves: Alternate, opposite, or in whorls of three per node, variable in shape, pubescence, and venation, usually sessile or with a petioloid base, rarely petiolate

Inflorescence/Flower: Heads homogenous, 300–500 or more, usually in racemose, paniculate, corymbose, or rarely simple inflorescences, discoid; disk florets 2–45 per head, corollas white or yellow, sometimes purplish-tinged, usually 2–7 mm long, ending in five triangular lobes, glabrous

Fruit: Achenes glabrous to hispid or grayish silky, 2–6.5 mm long

Seed: Seeds are small and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the dry achenes (fruits) when they are mature and dry, and keep them in a paper bag.
- Separate the dry seeds from the debris as recommended; desiccated seeds may keep viable for up to five years, or refrigerate them, keeping them dry.
- Surface sow these small seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1).
- Water the seeds in; keep them in a covered, shaded area.
- Water them every other day.

GERMINATION

- It may take one to three months for all viable seeds to sprout.
- In a month or two after sprouting, transplant your seedlings into 2–4-inch pots, handle them by the leaves only.
- Use a well-draining transplant mix.
- Keep them in the shade to an area with filtered light.

CUTTINGS

- Collect softwood tip cuttings 3–5 inches long with at least three nodes, in the morning hours. It is best if they are taken in the spring or summer months.
- Do not collect cuttings if the plants are flowering or drought stressed; they have a lower rooting percentage.
- Remove the lower foliage and cut the top foliage in half to reduce moisture loss through the leaves.
- Keep the cuttings moist at all times and out of full sun.
- Start cuttings as soon as possible, or store them for a day or so in the refrigerator in a sealed plastic bag to hold in the moisture.
- Use a shallow flat of moistened 3 parts perlite to 1 part potting mix (3:1) or 3 parts perlite to 1 part vermiculite (3:1).
- Recut the bottom end of the cuttings, just below the node, before inserting into the mix.
- No rooting powders are necessary; insert at least one of the bottom nodes into the potting mix.
- Water the cuttings in. Try to give the cuttings the moisture they need according to the species' natural habitats, from wet forests and bogs to dry lava flows and alpine deserts.
- Keep them protected from strong winds and heavy rains in a shaded, covered area.
- The na'ena'e cuttings will root in about two months, and up to six months if the cuttings were taken after summer.
- Once rooted, carefully remove them from the mix, trying not to disturb the delicate roots; repot into 4-inch pots.
- Use a well-draining cindery soil mix; add peat moss to the cinder for the wetter species.
- Water them in, keep them in the shade for two weeks, and then move them into more sun or keep them in the shade according to species and natural habitat.

OUTPLANTING

- *Dubautia* are more vulnerable to strong winds, drying out, and poor drainage.
- Choose a site with filtered light.
- Plant with other plants, such as trees, shrubs, and ground covers for added protection.
- For the best results, if the species is naturally found at higher elevations, try to accommodate it.
- Amend the soil as recommended, water them weekly for a month or so, then only water when it is very dry.

PESTS

- Control ant infestations from the base of the plant, as recommended.
- In pots, root mealybugs can be a problem. They can be controlled with systemic pesticides.
- Unidentified caterpillars also find some *Dubautia* species' foliage delicious. Pick them off by hand, or use a bacterial pesticide.

A

ASTERACEAE
(SUNFLOWER FAMILY)

GENUS:
Hesperomannia

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
H. arborescens (Syn: *Swezeyi*)	E/Ex	end (O, Mo, L, M) windward sea cliffs
H. arbuscula	E	end (O, M) mesic to wet forests
H. lydgatei	R	end (K) wet forests

Partial Sun

Range
Hawaiian Endemic

Description
small shrubby tree

Propagation
seeds



***Hesperomannia swezeyi* flowers—JA**

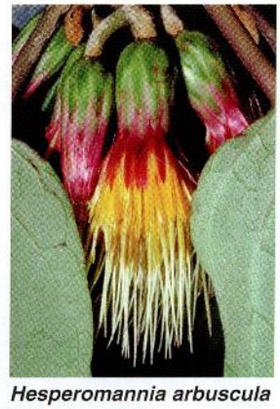
GENERAL DESCRIPTION

Hesperomannia grow as small trees to sprawling shrubs, with simple alternate leaves. Large orange thistle-like flower heads 2 inches long and bell-shaped, give way to dry heads that contain many long, thin, blackish achenes. The viable seeds have a thickness to them when pinched between the fingers, but if they are completely flat they have aborted embryos and will not germinate. This plant is threatened; goats and other introduced invasive species have degraded its environment. Most of the seeds I received had bug damage or were aborted and nonviable. This genus is quite a challenge to grow and maintain in the landscape. Most importantly, it needs a healthy, well-draining, cindery soil.

Entire Range: Hawaiian endemic
Wild Habitat: Mesic to wet forests, windward sea cliffs
Habit: Small shrubs or small shrubby trees
Mature Height: 6–30 ft (2–10 m)
Stem/Trunk: Young stems tomentose or glabrous

Leaves: Simple, alternate, usually 8–28 cm long, 2–11 cm wide, margins entire or sometimes serrate or dentate, especially juvenile leaves, the lower surface glabrous or densely to sparsely tomentose

Inflorescence/Flower: Flower heads large, solitary or two to ten in terminal clusters or in forks of the branches, discoid; florets perfect, corollas yellow to yellowish-brown, slender, 2–3 cm long, deeply cleft into five linear lobes, pappus (modified calyx consisting variously of hairs, scales, bristles, or a mixture of these) of numerous purplish-tinged or tan stiff bristles about twice as long as achenes



Hesperomannia arbuscula flowers—GDC

Fruit: Achene oblong to narrowly oblanceolate (inversely lanceolate), slightly flattened, and usually curved irregularly four to six angled or ribbed

Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect fruits (achenes) when they are dry and blackish in color. Clean the seeds and separate them from the debris as recommended for dry seeds.
- The seeds can be stored in desiccation chambers for up to five years, or refrigerated, keeping them dry.
- Soak the seeds in tap water for one hour; the seeds will float; then air-dry them.
- Surface sow the thin seeds on a dry seed mix, and then water them in.
- Keep them in a shaded area, and water them every other day.

GERMINATION

- It may take three weeks to two months for all of the viable seeds to sprout.
- Wait until they have four true leaves before transplanting.
- Use 2–3-inch pots; a well-draining cinder mix works best.
- Keep them in a shaded, protected area for several months, because they are slow-growing.
- Repot them every four to six months into larger pots and use new media, with small amounts of 8-8-8 NPK fertilizer.

OUTPLANTING (slow-growing)

- Outplant them in two years, when the plant has outgrown a 2-gallon pot.
- Choose a location in partial sun and with well-draining soil, and plant them with the protection of other plants.
- This is a very sensitive plant. Water weekly for a month, then only water when it is dry. Monitor the plants closely.

PESTS

- Root mealybugs, scales, and whitefly can all be a problem; control ants as recommended and pick off other bugs by hand. I would not use Malathion™ or other harsh chemicals on this plant; instead, spray with horticultural oils.



Hesperomannia lydgatei seed—NT



H. lydgatei seed heads—NT

A

ASTERACEAE
(SUNFLOWER FAMILY)

GENUS:
Keysseria (syn: *Lagenifera*)

HAWAIIAN NAME:
Hōwaiaulu

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
K. erici	R	end (K) bogs and moist areas
K. helenae	R	end (K) bogs
K. maviensis	V	end (Mo, M) bogs and wet forests

Shady

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds



***Keysseia mauiensis* flowers — SP**

GENERAL DESCRIPTION

Hōwaiaulu grows as a short branching perennial herb, often with rhizomes, or as a low subshrub with branches that root if they touch the ground. The tiny rosettes of leaves grow at the top of the branches; singular purple or yellow flower heads develop on top of long nonbranching spikes, as do the achenes. It is always best to grow rare plants from viable seeds instead of collecting plant material. In this case, divided rhizome cuttings propagate well. I have very limited experience with this genus, which occurs naturally in wet, boggy areas and consequently likes having its "feet" wet. To accommodate this outplant them, or keep them in a plastic pot with a saucer underneath to maintain a constant source of water close to the roots. Rainwater is the best, if it is clean and not contaminated.

Entire Range: Hawaiian endemic

Wild Habitat: Bogs, moist areas, and wet forests

Habit: Low subshrubs, branching or short branching perennial herb with underground horizontal rhizome stems

Mature Height: 1–14 inches in height

Stem/Trunk: 1–14-inch (3–35-cm) scapes (leafless or bracteate peduncle), moderately to densely hirsute (hairs), with few to many glands

Leaves: Simple, basal (basal rosette), sometimes distributed along the short stem, oblong, glabrous, sparsely covered with golden or purplish hairs, sparsely covered with glands, leaf margins entire, toothed, crenate, or serrate

Inflorescence/Flower: Flower heads solitary and terminal, sometimes a few in the leaf axils, on long peduncles; receptacle (in the asters the end of the peduncle to which all of the flowers of the floral head are attached) naked, ray florets pistillate, rarely staminate, rays conspicuous or sometimes inconspicuous and appearing disciform (shaped like a disk), white to purple, entire to two to four lobed; disk florets perfect or staminate, often sterile, corollas greenish to yellow, four to five lobed, pappus absent

Fruit: Achenes narrowly ellipsoid or obovoid, laterally compressed, contracted to the base, narrow above to a beak or at least with a thin collar at the tip, glandular

Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect achene fruits when they are mature and blackish.
- Keep them in a dry paper bag, until cleaned as recommended for small dry seeds.
- Soak them for ½ hour in tap water, then surface sow them on a dry seed mix of 2 parts perlite or 2 parts black cinder to 1 part potting mix (2:1) or surface sow them onto sphagnum moss and keep them in a mist system; water the seeds in after sowing.
- Keep them in a shaded, covered area and on the moist side.
- If there is no mist system, water them every day.

GERMINATION

- If the seeds are viable, they will germinate in two weeks. Wait until four true leaves develop.
- Transplant them into a 2-inch pot in moist, well-draining mix. Use 1 part black cinder to 1 part peat moss (1:1).
- Keep them in a moist, shaded area and repot every six months into new media and a larger pot.

OUTPLANTING

- Hōwaiaulu can be kept as a potted plant in a 1 part peat to 2 parts cinder mix (1:2), using small amounts of 8-8-8 NPK fertilizer. Put the pot in a shallow saucer with water for a bog effect.
- Choose a site with a bog, or a wet-forest area.

PESTS

- Control ants using the recommended bait.

A

ASTERACEAE

(SUNFLOWER FAMILY)

Sun–Shade[1]

Range
Hawaiian Endemic

Description
ground cover to perennial herb[2]

Propagation
seeds and cuttings

1: Sun requirements differ for each species.

2: Description differs for each species

GENUS: ***Lipochaeta***

HAWAIIAN NAME: **Nehe**

SPECIES	STATUS	HAWAIIAN RANGE
L. connata ssp. *acris*	AS	end (Ni, K)
L. connata ssp. *connata*		end (K, M)
L. degeneri	E/Ex	end (Mo)
L. heterophylla	AS	end (Mo, L, M)
L. lobata ssp. *leptophylla*		end (O)
L. lobata ssp. *lobata*	E	end (Ni, O, M)
L. rockii	AS	end (Mo, M, Ka, H)
L. succulenta	AS	end (HI exc. L)



***Lipochaeta succulenta* flowers — DR**

GENUS: ***Melanthera*** (syn: *Wollastonia*)

SPECIES	STATUS	HAWAIIAN RANGE
M. bryanii	E/Ex	end (Ka)
M. fauriei	E	end (K)
M. integrifolia	—	end (HI)
M. kamolensis	E	end (M)
M. lavarum	—	end (Mo, L, M, Ka, H)
M. micrantha spp. *exigua*		end (K)
M. micrantha ssp. *micrantha*	E	end (K)
M. perdita	E/Ex	end (Ni)
M. populiolia		end (L)
M. remya	R	end (O)
M. subcordata	AS	end (H)
M. tenuifolia	E	end (O)
M. tenuis	V	end (O)
M. venosa	E	end (H)
M. waimeaensis	E	end (K)



***Melanthera tenuifolia* flowers — SP**

GENERAL DESCRIPTION

Hawaiian nehe occur as sprawling perennial herbs, slightly woody at the base. They root easily along the stems at the nodes, and the roots grow into the soil, holding it in place (some species are great ground covers). The light-green, simple leaves are opposite, large and thin, or tiny and thick, depending on the natural habitat. Nehe were a dominant part of the understory in certain coastal and mesic forests; half of the species are rare, extinct, or vulnerable because of habitat loss, browsing animals, and/or the many introduced plants that are more aggressive than nehe.

Entire Range: Hawaiian endemic

Wild Habitat: Pili grassland slopes, remnant dry forests, coastal and sea level, dry coastal and dry shrubland, diverse mesic forest, open areas and near lava flows, dry forest, and dry-mesic forest, locally moist dry forest, and disturbed areas

Habit: Somewhat woody perennial, rarely annual herbs

Mature Height: 8 inches to 16 ft (2–50 dm)

Stem/Trunk: With erect, spreading to prostrate stems, sometimes rooting at the nodes

Leaves: Simple, opposite, mostly smooth or pubescent, entire or pinnately lobed, rarely compound, petiolate, the petioles often winged, or sessile and the bases connate-perfoliate (stem appears to pass through the leaf)

Inflorescence/Flower: Solitary heads or in cymose clusters, terminal, radiate, rays yellow, entire to toothed, disk florets perfect and usually fertile, corollas yellow, 4- to 5-merous, pappus often of scales, often tipped with an awn

Fruit: Achenes smooth to sometimes winged, greatly enlarging at maturity

Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the dry brown achenes in a paper bag, and keep them dry.
- Clean them as recommended for small dry seeds.
- Seeds can be stored in a desiccation chamber for up to six years, or refrigerated.
- No pretreatments are needed, surface sow the thin seeds, then water them in.
- Keep them in a covered, shaded area, and water them every other day.

GERMINATION

- It may take two weeks to two months for all of the viable seeds to germinate.
- Some of the endangered nehe have lower viability rates possibly from inbreeding.
- Transplant seedlings when they have at least four true leaves, in one to two months.
- Use a well-draining transplant mix, as recommended.
- Keep seedlings in the shade for one to two months, and then move them into more sun to help harden them off.

CUTTINGS

- Collect three-node softwood or green tip cuttings during the morning hours.
- Keep them moist in a sealed plastic bag.
- Remove all of the lower leaves and cut the top leaves in half.
- No rooting powders are necessary for herbs; make sure at least one node is buried under the mix.
- Use a mix of 3 parts perlite to 1 part potting mix (3:1) in a shallow flat, then water the cuttings in.
- Keep them in a shaded, covered area and water them every other day.
- If the cuttings dry out at any time before or during rooting, the survival rate is lowered.
- These cuttings will root in three months. At that time, gently remove the cuttings and pot them into 4-inch pots.
- Use the recommended transplant mix.



***Melanthera micrantha*—KLR**

OUTPLANTING

- Your nehe will be ready for outplanting in six months or when the seedlings and cuttings have outgrown a 4-inch or 1-gallon pot.
- Accommodate the plant by mimicking its natural habitat (sunny and dry, or moist and shady) and your results will be better.
- All species need well-draining soil.
- Apply an 8-8-8 NPK fertilizer every six months.
- These plants like to be trimmed back when their growth gets unruly; you can utilize the trimmings to make new cuttings.
- The small leaf from of *M. micrantha* makes a nice hanging basket plant; to accomplish this use a mix made up of 2 or 3 parts potting mix to 1 part cinder (3:1).
- Drier species planted in moist, humid, or shady areas suffer from powdery mildew on the leaves (a whitish dust). (*L. succulenta*)
- Do not overplant an area. Allow for space between the plants, at least a foot.
- Water the ground, not the foliage. If the mildew gets out of hand, dust the plant with a sulfur-based fungicide.

PESTS

- Ants found at the base of the plant can be controlled as recommended.
- Ants can also farm scales and mealybugs; use the recommended ant protocol to keep them under control.

A

ASTERACEAE
(SUNFLOWER FAMILY)

GENUS:
Pseudognaphalium (syn: *Gnaphalium*)

HAWAIIAN NAMES:
'Ena'ena; pūheu

COMMON NAME:
Cudweed

SPECIES	STATUS	HAWAIIAN RANGE
P. sandwicensium var. *hawaiiense*	—	end (M, H)
P. sandwicensium var. *kilaueanum*		end (H)
P. sandwicensium var. *molokaiense*		end (O, Mo, L, M)
P. sandwicensium var. *sandwicensium*		end (HI exc. Ka)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds and cuttings



Pseudognaphalium sandwicensium **– NTBG nursery — KLR**

GENERAL DESCRIPTION

Perennial herbs, found on all the main islands from sea level to higher elevations. This small shrub has clustered basal leaves 2–4 inches long, silver-green, and fuzzy. These are usually short-lived plants if they are allowed to flower. They will live years longer if all the flowers are trimmed off before seeding, unless you want to collect the seeds. These plants are grown more easily from cuttings. *P. sandwicensium* var. *molokaiense* seems to be more difficult to propagate (my experience has been that the seeds will take up to two years to germinate) and maintain than the others.

Entire Range: Hawaiian endemic, Kure and Midway Atolls

Wild Habitat: Dry areas, clay or consolidated sand dunes, bare coastal areas, sea level to higher elevations, especially on lava or cinders

Habit: Perennial herb

Mature Height: 4–26 inches (1–6.5 dm)

Stem/Trunk: Herbaceous, olive-green to white or gray, erect to prostrate, unbranched to many-branched

Leaves: Linear-spatulate to spatulate (shaped like a spatula), 1–6.6 cm long, 1–30 mm wide, reduced upper leaves, both surfaces densely woolly pubescent (bearing hairs)

Inflorescence/Flower: Flower heads in terminal, corymbose or sometimes globose, clusters

1.5–7 mm in diameter, involucral bracts (a set of bracts beneath an inflorescence) whitish to pale yellow, sometimes obscured by dense woolly hairs

Fruit: Small achenes

Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



P. sandwicensium flowers—DB

- To propagate by dry achenes, first collect the seeds when they are dry and brownish-tan in color, keep them in a paper bag until they are ready to be cleaned.
- Separate the seeds from the debris, as recommended for cleaning small dry seeds.
- The seeds can be stored in a desiccation chamber for up to four years, or refrigerated and kept dry.
- No pretreatments are needed.
- Surface sow the small seeds onto a dry mix, water them in, then water them about every other day.
- Keep your seedling flat in a protected area, and on the dry side.

GERMINATION

- Germination takes from two months to two years for all viable seeds to sprout in the flat.
- Transplant them within a month after germinating, and when the seedlings have four true leaves.
- Use 2–4-inch pots with a well-draining transplant mix; amended with cinder.
- Water in the seedlings; keeping them in a shaded area for three weeks, then move them into an area with more sun.

CUTTINGS (fast and easy)

- It is important to avoid propagating this plant when it is blooming, as this is a weak growth phase.
- To propagate by cuttings, collect the green tip cuttings, 3 inches long, in the early morning; keep them moist and out of the sun.
- Remove all of the lower foliage 1½ inch up, and then cut the top foliage in half.
- Use a mix of 3 parts perlite to 1 part vermiculite (3:1), which works well, and roots fast; no rooting powders are needed.
- Insert at least one node into the mix in a shallow flat.
- Water them in, then water them every two to three days, keeping them on the dry side. Do not allow the cuttings to dry out completely.
- Keep them in a covered, shaded area to control moisture.
- It may take one to three months to root; once they do, pot them into 2–4-inch pots, using a well-draining mix.
- Water them in, and keep them in the shade for a month, then move them into more sun.

OUTPLANTING

- Outplant them when they outgrow 4–6-inch pots in about six months.
- Choose a site in filtered to full sun, in rocky, free-draining soil.
- This plant will re-seed itself and spread throughout your garden in time.
- Water weekly for a month, then water only in times of drought.

PESTS

- The worst pest of 'ena'ena is the painted lady caterpillar, which eats the leaves and tips of the plant if it is not controlled. In extreme cases, it can kill the plant. To control it, either pick off the caterpillars by hand or apply a bacterial pesticide (*Bacillus thuringiensis*) following the directions on the label carefully.
- If these plants are in soil that is holding too much moisture, they will succumb to root fungus, which will eventually kill them.



Painted lady caterpillar—DR

ASTERACEAE

(SUNFLOWER FAMILY)

GENUS:

Remya

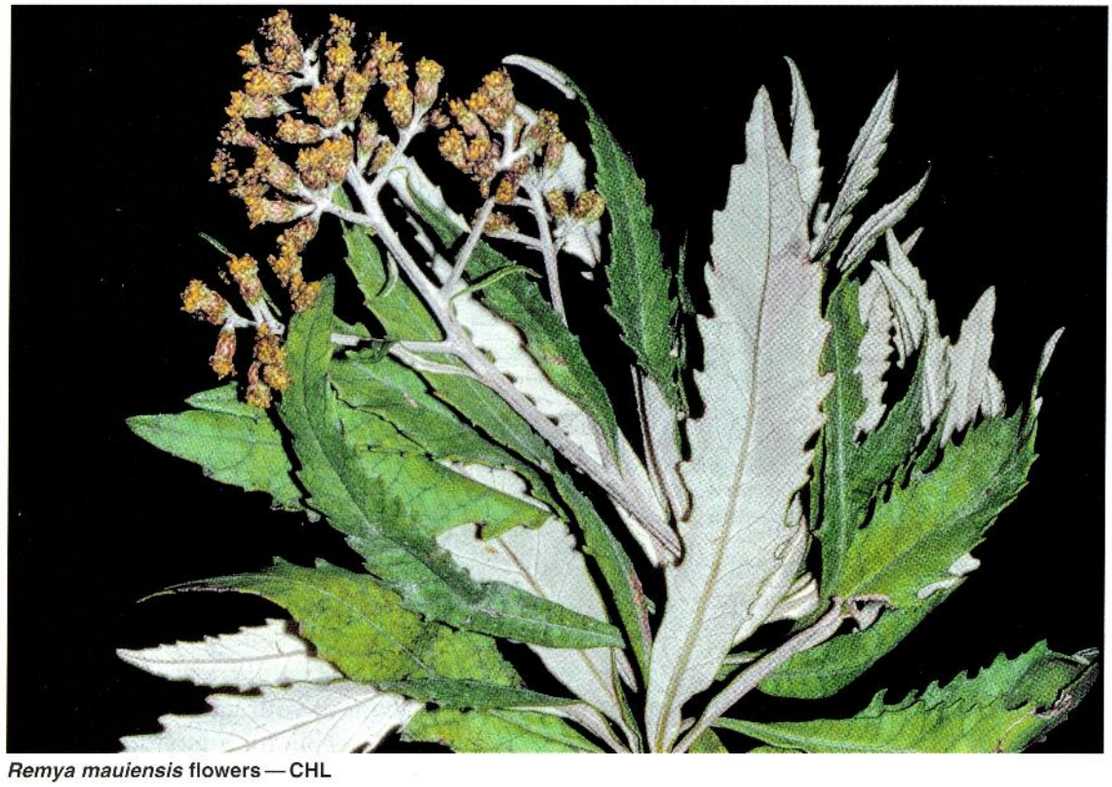
SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
R. kauaiensis	E	end (K) mesic forest
R. mauiensis	E	end (M) mesic forest
R. montgomeryi	E	end (K) one population on steep cliffs

Partial Sun

Range
Hawaiian Endemic

Description
sprawling shrub

Propagation
seeds and cuttings



***Remya mauiensis* flowers — CHL**

GENERAL DESCRIPTION

Remya are rare shrubs, with whitish hairs on young stems (*R. kauaiensis* and *R. mauiensis*), found in small, scattered populations in mesic forests. The simple, alternate leaves are toothed along the edges and cluster near branch ends; flowers and achenes form at the ends of long branching spikes. The wild-source seeds I worked with seemed to have low viability. They are all endangered and getting closer to extinction because goats and other grazing animals find this plant delectable. Introduced pigs looking for grubs, also dig up the plant in the wild, destroying them. These introduced animal activities could reduce it to extinction; their demise will be our loss.

Entire Range: Hawaiian endemic
Wild Habitat: Mesic forest to steep cliffs
Habit: Weakly branching, sprawling shrub
Mature Height: 3–12 ft (1–4 m)
Stem/Trunk: Densely tomentose or glabrous shrubs with sprawling stems
Leaves: Simple, alternate, narrowly elliptic, broadly ovate, or lanceolate, lower surface white tomentose or glabrous, margins serrate to dentate, short petiolate
Inflorescence/Flower: Flower heads in terminal panicles, disciform (shaped like a disc); ray

florets pistillate, rays inconspicuous and emarginated (having a small notch at the tip), cream colored, or vestigial, stamens absent; two types of florets: outer row, pistillate with corollas, inner ones functionally staminate, or corollas funnelform (shaped like a funnel), both types dark yellow, 4- to 5-merous

Fruit: Achene narrowly obovoid, compressed

Seed: Small, dry seeds (Wagner et al. 1990)



***Remya montgomeryi* seeds – Kaua'i — SP**

PROPAGATION AND CULTIVATION

SEEDS (difficult)

- These seeds have a very low viability to no germination at all.
- To propagate by seeds, first collect the achenes (fruits) when they are dry and brown, and keep them in a paper bag.
- Clean them as recommended for small dry seeds.
- Surface sow the seeds onto a mix of 2 parts perlite to 1 part potting mix (2:1) or 2 parts black cinder to 1 part potting mix (2:1).
- Water the seeds in, and then water them every other day.
- Keep them in a cool, shaded, and covered area.

GERMINATION

- It may take two weeks to six months for all viable seeds to sprout.
- Transplant, handle, and outplant the same as for *Hesperomannia* (pg.89).
- Again, it is important to plant this genus in well-draining soil, but not so well-draining that it will not hold moisture; amend the soil as recommended with cinder.

CUTTINGS

- Use 3-inch long tip cuttings.
- Reduce the leaves by cutting them in half.
- Keep the cuttings moist in a sealed plastic bag until you are ready to get started.
- Use a mix of 3 parts perlite to 1 part vermiculite (3:1).
- Apply rooting powder No. 1, or none at all.
- Keep the cutting in a mist system for best results.
- Rooting will occur in three to six months, pot into well-draining media mix amended with black cinder.

OUTPLANTING

- *Remya* are more vulnerable to strong winds, drying out and poor drainage.
- Choose a site in filtered light.
- Plant with other plants, trees, shrubs and ground covers for added protection.
- For the best results, if the species is found at higher elevations, try to accommodate that.
- Amend soil as recommended, water weekly for a month or so, then when very dry.

PESTS

- Pests include ants in the pot or at the base of an outplanted plant. They farm scales and root mealybugs; control them as recommended; spray horticultural oil and use ant bait.

A

ASTERACEAE

(SUNFLOWER FAMILY)

GENUS: ***Tetramolopium***

HAWAIIAN NAME: **Pāmakani**

Fourteen new subspecies and varieties have been recognized (Wagner 2012).

Their not added to this list, all *Tetramolopium* are grown in the same way.

SPECIES	STATUS	HAWAIIAN RANGE
T. aremarium	Ex	end (M, H)
T. capillare	E	end (M)
T. consanguineum	R	end (K?, H)
T. conyzoides	E/Ex	end (Mo, L, M, H)
T. filiforme	E	end (O)
T. humile	AS	end (M, H)
T. lepidotum	E/Ex	end (M, O, L)
T. remyi	E	end (L, M)
T. rockii	V	end (Mo)
T. sylvae	R	ind (Mo, M)
T. tenerrimum	E/Ex	end (O)

Partial Sun – Full Sun[1]

Range
Hawaiian Endemic

Description
small shrub to prostrate clump

Propagation
seeds

1: Sun requirements differ for each species.



***Tetramolopium rockii* flowers — DR**

GENERAL DESCRIPTION

Tetramolopium grow as small erect shrubs or prostrate clumps, in coastal shrubland to alpine deserts. The small, narrow leaves are alternate and tightly clustered at the branch ends. The tiny flower heads are clustered or solitary on the top of long spikes, as are the dry achenes. Out of the eleven species, ten are thought to be extinct in the wild, endangered, rare, or vulnerable. These plants taste good to introduced grazing animals. If viable seeds are collected, they are easy to grow and maintain in the landscape, providing they are outplanted in a well-draining cinder soil. Different species, if kept in the same area, will cross-pollinate easily and produce hybrid seeds, no wonder there is so many different species and new ones yet to be discovered.

Entire Range: Hawaiian endemic

Wild Habitat: Coastal shrublands to alpine deserts

Habit: Shrubs or prostrate clumps
Mature Height: 1 inch to 6.6 ft (2.5–200 cm)
Stem/Trunk: Stems sympodially branched, each terminated by an inflorescence
Leaves: Simple, alternate, margins entire or dentate, usually petiolate (with a petiole)
Inflorescence/Flower: Flower heads solitary or five to sixty in loose-to-congested corymbose panicles, peduncles glabrous or variously pubescent, radiate, pistillate rays white or tinged pink or pale lavender; disk florets perfect or functionally staminate, corollas yellow, purple, or pinkish, tubular or narrowly funnelform, five-lobed; pappus of white, brown, or yellow bristles
Fruit: Achenes
Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)


Tetramolopium filiforme **seeds – NTBG nursery—DR**

- To propagate by seed, first collect the small achenes (fruit) when they are mature, dry, and falling from the plant; keep them dry in a paper bag.
- Separate the dry seeds from the debris as recommended; desiccated seeds may keep viable for up to five years, or refrigerate them making sure they stay dry.
- Soak the seeds in tap water for one hour, and then air-dry the seeds, for faster germination.
- Surface sow the small seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1).
- Water the seeds in; keep them in a covered, shaded area.
- Water them every other day.

GERMINATION

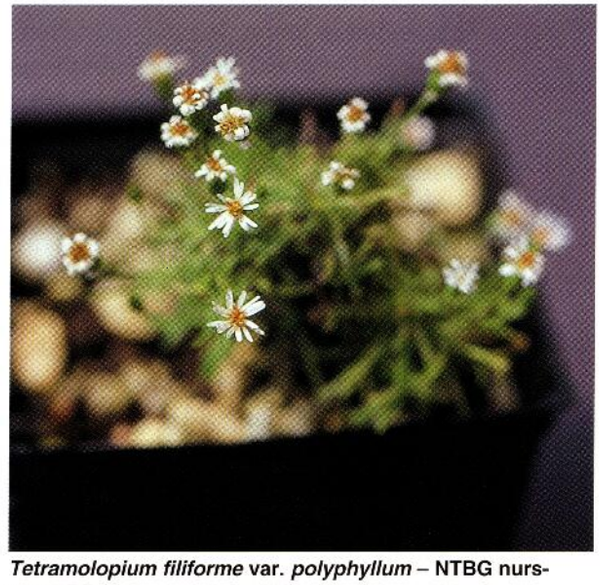
- It may take one to three months for all of the viable seeds to germinate.
- In a month or two after sprouting, transplant your tiny seedlings into 2- to 4-inch pots, handle them by the leaves only; the roots are very sensitive at this stage.
- Use a well-draining cindery transplant mix.
- Keep the potted seedlings in the shade for two weeks, and then move into more sunlight to harden off.
- You can keep your pāmakani in a pot, repotting it every six to eight months, with new well-draining soil mix and small amount of 8-8-8 NPK fertilizer.

OUTPLANTING

- Pāmakani are more vulnerable to strong winds, drying out, and poor drainage.
- Choose a site with partial to full sun, depending on the species' native habitat.
- Plant with other plants such as trees, shrubs, and other small plants for added protection, allowing each plant room to grow.
- The best results, if the species is found at higher elevations, try to accommodate those conditions.
- Amend the soil as recommended for good drainage; water them weekly for a month or so until established, then only water when it is very dry.

PESTS

- Control ant infestations from the base of the plant as recommended.
- In pots root mealybugs can be a problem. They can be controlled with systemic pesticides.


Tetramolopium filiforme **var. *polyphyllum* – NTBG nursery—DR**

A

ASTERACEAE
(SUNFLOWER FAMILY)

GENUS:
Wilkesia

HAWAIIAN NAME:
Iliau

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
W. gymnoxiphium	AS	end (K) dry to mesic forest

COMMON NAME:
Dwarf Iliau

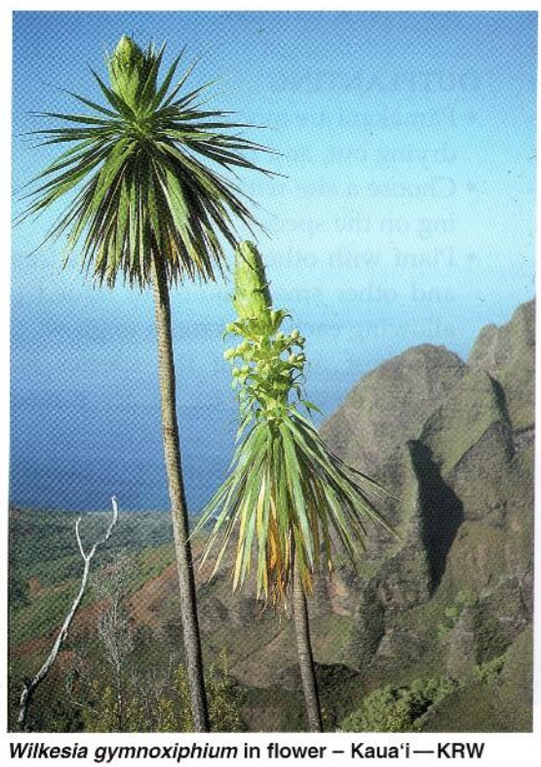
SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
W. hobdyi	E	end (K) very dry ridges

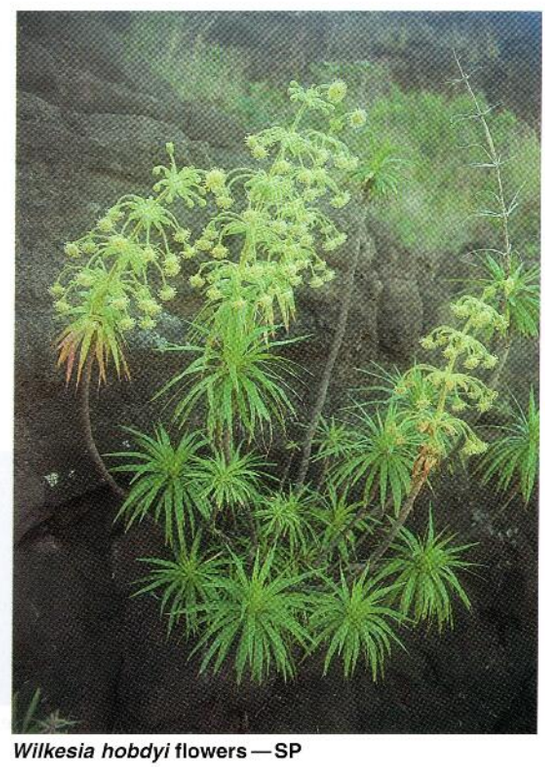


Range
Hawaiian
Endemic

Description
rosette shrub

Propagation
seeds


Wilkesia gymnoxiphium **in flower – Kaua'i — KRW**


Wilkesia hobdyi **flowers — SP**

GENERAL DESCRIPTION

This endemic genus is only found on Kaua'i. It is closely related to the greenswords and na'ena'es (*Dubautia*), but is different from both in appearance. The thin, light-green leaves of the iliau are arranged in whorls and are flat, like grass. The inflorescence is whorled, with large, disc flower heads, and the entire plant dies after flowering (*W. gymnoxiphium*). Iliau is well adapted to rocky, open sites in dry to mesic forests. This is a beautiful and easy plant to grow and maintain in the landscape. I have seen them growing healthily in cultivation at 50 feet above sea level.

Entire Range: Kaua'i endemic genus

Wild Habitat: Dry to very dry ridges, dry to mesic forests

Habit: Erect, solitary (*W. gymnoxiphium*), to branched (*W. hobdyi*), monocarpic (dying after final flowering event) to polycarpic rosette shrubs

Mature Height: 3–15 ft (1–5 m *W. gymnoxiphium*); 2 ft (0.7 m *W. hobdyi*)

Stem/Trunk: Stems ringed with conspicuous leaf scars, naked except for the tufts of leaves near the apices


Wilkesia gymnoxiphium **flowers – Kaua'i — KRW**

Leaves: Leaves green, in whorls of seven to fifteen, narrow, sword-shaped, entire, bases connate (fused)

Inflorescence/Flower: Flower heads with perfect flowers, 10–350 arranged in viscid-glandular (sticky) inflorescences; corollas cream colored, five-lobed, 4–6.5 mm long, pappus of lanceolate scales

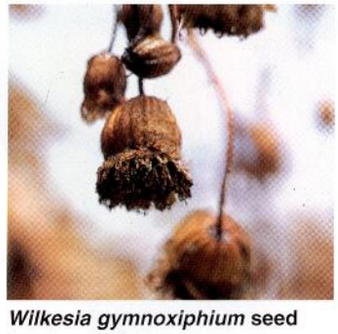
Fruit: Achenes 4.5–7 mm long, ascending, silky

Seed: Small, dry, seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

Note: *W. gymnoxiphium* has sticky achenes, which are hard to clean. *W. hobdyi* is harder to grow and maintain at lower elevations.

SEEDS (easy)



***Wilkesia gymnoxiphium* seed heads—DR**

- To propagate by seeds, first collect the sticky fruits, which are dry and brown when ripe, and keep them in a dry paper bag.
- Clean the seeds from the large flower heads, as recommended for dry seeds.
- Seeds can be stored in desiccation chambers for up to seven years, or at room temperatures.
- Surface sow the seeds on a mix made up of 3 parts perlite to 1 part potting mix (3:1) in shallow flats, water the seeds in.
- Keep seed mix on the dry side, in a covered area.

GERMINATION (fast)



***Wilkesia gymnoxiphium* seedlings – NTBG nursery—DR**

- It may take five days to six months for all of the viable seeds to germinate.
- Transplant them in about one month, when the seedling has at least four true leaves.
- Use 2 – 3-inch pots with a well-draining and cindery transplant mix.
- Repot them when the roots start to fill the bottom of the pot. It is important not to allow the roots to become root-bound at any time, because damaged roots will kill the plant in a few years; it can also cause the plant to blow over easily during strong winds after outplanting.
- Keep them in the shade for one month to strengthen them, and then move them into more sun to help them acclimate.

OUTPLANTING



***Wilkesia gymnoxiphium* outplanted – NTBG—CC**

- In six months, these fast-growing plants may be ready for outplanting into well-draining soil in the full to partial sun; amend as discussed with cinder.
- If planted in moist locations with poor drainage, iliau will die from root-rot.
- Fertilize with 8-8-8 NPK fertilizer every six months, or foliar feed your plants every three to six months.
- Water once a week for a month, then only water them in times of prolonged drought.

PESTS

- The biggest problem for dwarf iliau is an agromyzidae fly stem miner (*Melanagromysa splendes*). The fly lays its eggs in the stem, and then the larva eats the pith of the stem, killing the plant. Apply a systemic pesticide for management.
- If there are ants and weeds at the base of the plant, control them as recommended.
- Root nematodes can become a problem to the roots by causing root galls and if left untreated cause slow decline to death. Amend soil with a nematocide or a neem oil soil drench.
- Spittle bugs can be washed off with hose water and rubbed off with your fingers.

B

BEGONIACEAE

(BEGONIA FAMILY)

GENUS:

Hillebrandia

HAWAIIAN NAMES:

Pua maka nui; aka'aka'awa

SPECIES	STATUS	HAWAIIAN RANGE
H. sandwicensis	—	end (K, O, Mo, M)

Shady

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds and rhizome cuttings



H. sandwicensis **– Maui—F&KS**

GENERAL DESCRIPTION

Hillebrandia is a monotypic genus (only one endemic species in the genus) that has an obscure relationship within the begonia family. The large, fleshy leaves are covered with tiny hairs and have five to nine lobes along the edge. Pink to white flowers cluster and hang from atop long spikes near the top of the foliage. In the spring these plants spread and grow along tuberous rhizomes. The easiest way to propagate the Hawaiian begonia is by using rhizome cuttings. The begonia will go dormant, and all the vegetation will die back, giving the rhizome time to grow stronger and larger. Then, after a few months, during the wet season it will develop new foliage and flower. *Hillebrandia* does best in cooler temperatures. In the mid-elevation nursery, *Hillebrandia* became weedy in the nursery mist area, spreading by seed to pots close by and germinating.

Entire Range: Hawaiian monotypic endemic
Wild Habitat: Wet forests, mesic forests, and shady ravines, occurs about 3,000 ft (1,000 m) elevation
Habit: Succulent, erect, perennial herb
Mature Height: 20–40 inches (5–10 dm)
Stem/Trunk: Glabrous (smooth) to sparsely pubescent (hairs present) with long reddish-brown hairs about 2 mm long, from shallow, yellowish, tuberous rhizomes
Leaves: Asymmetrical, circular in outline, 10–24 cm in diameter, covered with short, white hairs, especially along the veins and underside of the leaves, irregularly lobed with serrate margins, stipules
Inflorescence/Flower: Monoecious (separate male and female flowers on one plant), peduncles 10–30 cm long, bracts bright pink to white, cordate (heart-shaped) to ovate (egg-shaped in outline), perianth bright pink to white, stamens yellow (male), petals spatulate (shaped like a spatula), ovary wingless
Fruit: Capsules 0.8–1.3 cm diameter
Seed: Small, pale, reddish-brown, oblong seeds 0.5 mm long, in dry capsules (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the capsules when they are brown and dry. Keep them in a dry paper bag.
- Separate the small seeds from the dry capsules, as directed for small dry seeds.
- No pretreatments are needed; surface sow the seeds onto a mix of 2 parts black cinder to 1 part potting mix (2:1).
- Keep the seed flats in a mist system or in a covered, shaded, moist area.

GERMINATION

- Allow two weeks to two months for all of the seeds to sprout.
- Wait until the very small seedlings grow four to six true leaves.
- Then transplant them into 2-inch pots, in 1 part black cinder to 1 part potting mix (1:1); this drains very well.
- These seedlings are very sensitive to drying out; keep them in a cool, moist place.
- Repot them into larger pots and new soil mix every six to eight months.

CUTTINGS (rhizome)

- Collect rhizome cuttings by digging under the plant and taking cuttings off as 3–4-inch pieces.
- Remove all vegetation and keep the rhizomes in a sealed plastic bag, out of direct sunlight, until they are potted.
- Plant them in a shallow pot 3 inches deep to accommodate the rhizome length, in 2–3 parts black cinder to 1 part potting mix (3:1).
- If the rhizome is handled correctly, it should sprout new growth within a few months.
- Repot them into larger shallow pots using new media every six to eight months.
- Do not let the cuttings ever dry out.

OUTPLANTING

- When the plant has outgrown an 8-inch to 1-gallon pot (about two years), it is ready for outplanting.
- Choose a cool, shady, moist to wet location, in well-draining cinder-type soil.
- Or keep it as a potted plant in a large shallow container.
- Before planting in drier soils, amend soil with polymer.
- Mix the wet polymer and fertilizer into the soil dug from the hole before planting.

PESTS

- Slugs love to feed on fleshy herbaceous plants; baiting can control them.

B

BORAGINACEAE

(BORAGE FAMILY)

GENUS:
Cordia

HAWAIIAN NAMES:
Kou

SPECIES	STATUS	HAWAIIAN RANGE
C. subcordata		ind (HI exc. Ka) dry coastal areas

Full Sun

Range
Indigenous

Description
tree

Propagation
seeds



Kou flowers—KLR

GENERAL DESCRIPTION:

Kou is a fast growing, easy to propagate tree, suitable for hot coastal landscapes. Used in ancient and in present times as an excellent shade tree with large evergreen leaves and a wide-spreading crown. Throughout the Pacific the orange scentless flowers are used in leis and are associated with many everlasting myths and legends and the seeds were regard as a famine food.

Kou's durable yet easily worked wood has been flawlessly carved into 'umeke la'au (wooden containers) for food and water, as well as house posts, outrigger canoes and other carved artifacts. Kou is known as one of the four best woods, koa, milo and kamani others for carving in Hawai'i (Abbott et al 1992).

Kou seeds and thought to be transported to Hawai'i by early Polynesians. It is now believed to be an indigenous species, as evidenced from sediments at Makauwahi Cave (Burney et al 2001). This evidence indicates that kou seeds arrived before man, probably by wave-flotation.

Range: Indigenous to Pacific Islands, in Hawaii on all main Hawaiian Islands except Kaho'olawe.

Wild Habitat: Forming thickets, sometimes wide-spread in low elevation, dry, coastal areas.

Habit: Tall, erect trees 17-34 feet, 23 feet spread, readily producing shoots from extensive shallow roots. Trunk bark mottled pale gray to tan, grooved and flaky.

Leaves: leaves thin, coriaceous, broadly ovate to elliptic, blades 10-20cm long, 8-16cm wide, tomentose along the main veins on the lower surface, otherwise glabrous, margins entire to undulate, apex acuminate, base subcordate to rounded or acute, petioles 4-12 cm long.

Flowers/inflorescence: Flowers in open cymes; calyx pale green, glossy, ca 1cm long, the lobes ciliate; corolla orange 5-7 lobed, the tube darker than the lobes, 2.3-3cm long, the lobes wrinkled, 3-4.5cm long.

Fruit/seeds: Fruit green when young, becoming brown and dry at maturity, subglobose to broadly ovoid, sometimes slightly asymmetrical, 2-3cm long, surrounded by the enlarged persistent calyx, seeds 4, white, usually 1-1.3cm long. (Wagner et al. 1990)

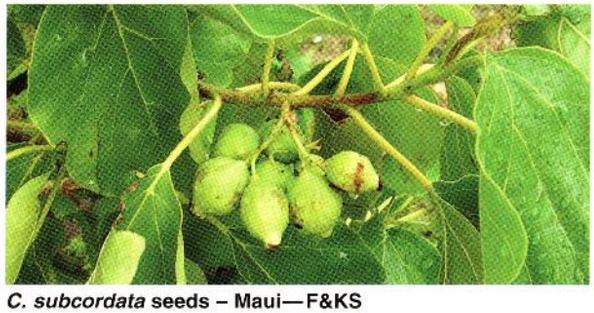
PROPAGATION AND CULTIVATIONS

SEEDS (easy)

- To propagate by seed, first collect the brown fruits when mature and falling to the ground. Keep dry in a paper bag until sowing.
- Start the fruits fresh; soak them in water for 24 hours to hurry germination. They'll float (that is how they traveled to the islands). Let dry.
- Place the treated fruits in a shallow flat or 6 inch pot of 3 parts perlite to 1 part potting mix (3:1). Water them in.
- Keep the flat in a covered protected area. Water every other day or when dry.

GERMINATION

- In a month or so, move the sprouting seedlings into an area with partial sun for healthy growth.
- The fruit contains four seeds which may sprout at the same time. Once each of the seedlings has two true leaves, gently separate each one.



***C. subcordata* seeds – Maui—F&KS**



Kou seedlings—KLR

- Transplant the seedlings into their own 4-inch pots with a well-draining mix. Poor drainage and too much moisture in the media will rot the roots.
- Keep newly potted seedlings in the shade for a week or so, and then move them into full sun to harden them off.
- Water them when they are dry; fertilize with a foliar feed every month for vigorous growth.
- Repot them every three to five months into one gallon pots adding new media.

CUTTINGS

- Not recommended for trees. Kou seeds grow fast and develop a healthier root system than cuttings.

OUTPLANTING

- Ready for outplanting when the tree has outgrown a 1-gallon pot in about six months to a year.
- Kou tend not to become root bound in the pots because of their fibrous root system. By comparison, a koa seedling easily becomes root bound in pots due to its fast growing tap roots.
- When preparing to outplant, choose a dry location in the full sun with well-draining soil and amend the soil as recommended.
- Water in the plants at first, then only water periodically when dry. If there is a water shortage, presoaked polymer granules can provide the temporary moisture needed.
- Fertilize your kou with 10-10-10 every six months or foliar feed monthly for faster growth.

PESTS

- Mealybugs on the plant and in the roots can attack kou; baiting can control the ants and the mealybugs can be managed with a systemic pesticide.

B

BORAGINACEAE

(BORAGE FAMILY)

GENUS:

Heliotropium

HAWAIIAN NAMES:

Kīpūkai; hinahina, hinahina-ku-kahakai pohinahina; nena; po'opo'ohina

COMMON NAME:

Seaside heliotrope

SPECIES	STATUS	HAWAIIAN RANGE
H. anomalum var. *argenteum*	—	end (Le, HI exc. L, Ka)
H. curassavicum	—	ind (KI, Le, HI)

Full Sun

Range
Endemic and Indigenous

Description
subshrub to perennial herb

Propagation
seeds and cuttings

1: Range differs for each species.



***Heliotropium anomalum* flowers — M. Clark**

GENERAL DESCRIPTION

H. anomalum var. *argenteum* has narrow leaves that are either hairy, silvery-gray, and densely clustered toward the tips. *H. curassavicum* is glabrous (without hairs) and is thick and fleshy, and blue-gray in color. The white, fragrant flowers are on top of long, forked stalks; green nutlets (fruit) are divided into four chambers that swell when the seeds are mature and contain one small tan seed per chamber. Hawaiians used the plant in lei making, and it is the official flower of Kaho'olawe (McDonald 1989) (*H. anomalum* var. *argenteum*).

Entire Range: Indigenous to Polynesia, Pacific Islands, N. America to S. America, W. Indies, Pacific Islands, Australia; in Hawai'i: all main Hawaiian Islands and Laysan, Nihoa, and French Frigate Shoals

Wild Habitat: Coastal dry sandy beaches above high-tide mark

Habit: Prostrate subshrubs or perennial herbs growing in stretched vegetation mats

Mature Height: 4–20 inches (1–5 dm)

Stem/Trunk: Stems from deep rhizomes, prostrate (lying flat) or decumbent (reclining), succulent or woody at the base, sometimes ascending and branching

Leaves: Usually alternate, margins usually entire, sessile (without a stalk) or petiolate (with a stalk)

Inflorescence/Flower: Sweetly scented flowers in scorpiod (coiled at the apex like the tail of a scorpion), bractless cymes, corolla white with a greenish or yellowish center, funnelform (*H. curassavicum*) or congested, bracteate cymes, corolla white to pale purple and funnelform (*H. anomalum*)

Fruit: Dry, lobed or unlobed fruits, eventually breaking into two to four hard nutlets with one or two seeds each

Seed: Small tan seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATIONS

SEEDS (easy)

- To propagate by seeds, first collect the swollen nutlets when they are brown.
- Keep them in a dry paper bag to allow any immature seeds to mature.
- Separate the seeds from the nutlets as recommended for small dry seeds.
- Start the seeds fresh, surface sow onto the surface of a 3 parts perlite to 1 part potting mix (3:1) or 3 parts perlite to 1 part vermiculite (3:1), and water them in.
- Keep them in a covered area to protect them from heavy rains.

GERMINATION

- It may take from one to three months for all viable seeds to sprout.
- Transplant when the tiny seedlings have four true leaves, after another month.
- Use 2-inch pots with well-draining mix, keep them in the shade for two weeks.
- Move them to a full sun location to harden them off before outplanting.

CUTTINGS (easy)

- In the morning, take herbaceous tip cuttings 3–6 inches long, and keep them moist in a sealed plastic bag until they will be potted; using an ice cooler works well for transporting your cuttings; keep them cool and out of direct sunlight.
- Remove the lower foliage; no rooting powder is needed.
- A mix of 3 parts perlite to 1 part vermiculite (3:1) works best, in a shallow flat, stick one to two nodes below the mix; water the cuttings in, then water every other day; never let the media dry out completely.
- Keep them in a covered, protected area.
- In two to three months, when they are well rooted, pot them into 4-inch pots, with a well-draining sandy mix.
- **Note**: It is best to grow this plant from seeds unless you own a plant to take cuttings from, the wild populations are already stressed from habitat destruction and cultural practices.



Heliotropium anomalum **outplanted NTBG—CC**

OUTPLANTING

- In six months, your seedlings or cuttings may have outgrown the 4-inch pots and are ready to be outplanted.
- Choose a site in full sun with well-draining sandy soil or cinder; with their blue-gray foliage, they make a beautiful ground cover when planted to grow over black rocks and cinder.
- Water in at first for a week, then only water in times of prolonged drought.

PESTS

- Mealybugs on the plant and in the roots can attack *Heliotropium*; baiting can control the ants and the mealybugs can be managed with a systemic pesticide.

B

BRASSICACEAE
(MUSTARD FAMILY)

GENUS:
Lepidium

COMMON NAMES:
Pepperwort; peppergrass

HAWAIIAN NAME:
ʻĀnaunau

SPECIES	STATUS	HAWAIIAN RANGE
L. arbuscula	R	end (O)
L. bidentatum var. *o-waihiense*		ind (HI exc. Ni, Ka)
L. orbiculare		end (K)
L. remyi		end (H)
L. serra	R	end (K)

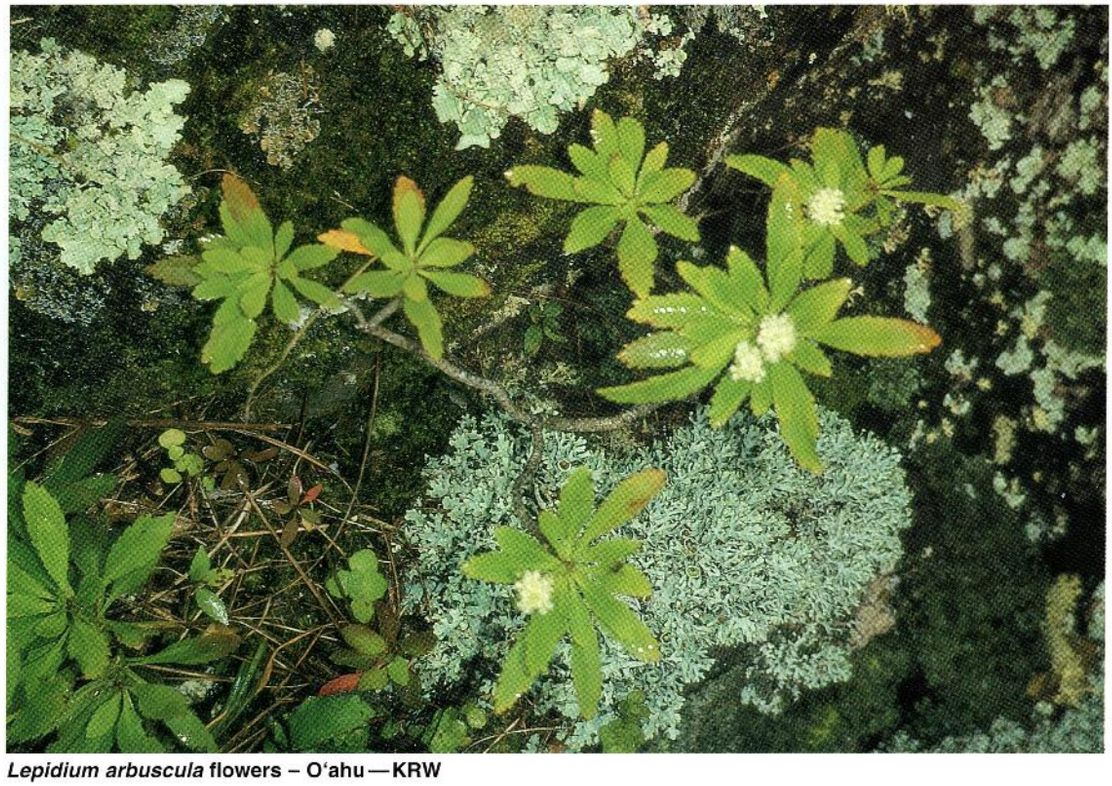
Partial Sun

Range
Endemic and indigenous[1]

Description
small subshrubs

Propagation
seeds and cuttings

1: Range differs for each species.

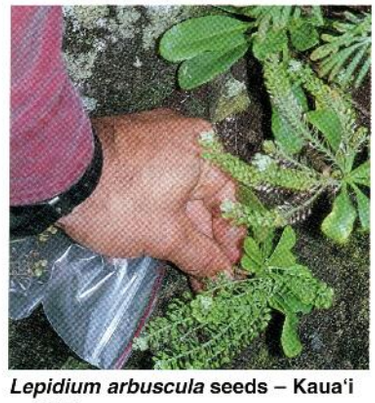


***Lepidium arbuscula* flowers – Oʻahu—KRW**

GENERAL DESCRIPTION

The leaves have a nice, peppery taste and cluster at the ends of the thin branches; the mature plants readily regenerate themselves, becoming weedy in the landscape or nursery, which is a good thing.

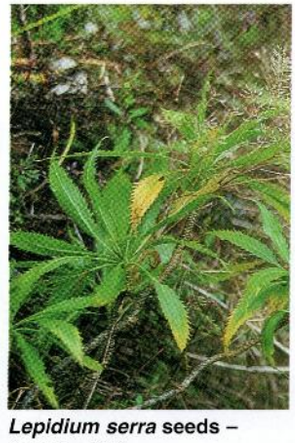
Entire Range: Indigenous and Hawaiian endemic
Wild Habitat: Steep, dry, rocky slopes; wetter habitats on Kauaʻi
Habit: Small subshrubs, gnarled shrubs
Mature Height: 1–3 ft (0.3–1 m)
Stem/Trunk: Stems ascending to weakly erect, herbaceous
Leaves: Leaves crowded at branch ends, coriaceous (leathery) or somewhat fleshy, margins serrate
Inflorescence/Flower: Flowers in racemes
Fruit: Small, flat silicles (short fruit in mustard family); mucilaginous when wet (may have been facilitated in bird dispersal)
Seed: Seeds, small, reddish-brown (Wagner et al. 1990)



***Lepidium arbuscula* seeds – Kauaʻi —KRW**

PROPAGATION AND CULTIVATION

SEEDS (easy)



***Lepidium serra* seeds – Kaua'i—SP**

- To propagate by seeds, first collect the small, scale-like fruits from the top of the plant after they have dried and turned brown.
- Keep them in a dry paper bag until they are cleaned.
- Separate the seeds from the dry fruit as recommended for small dry seeds.
- Seeds can be desiccated for up to eight years or stored dry in the refrigerator.
- No pretreatment is necessary; surface sow the small reddish-brown seeds onto a dry seed mix.
- Water the seeds in; keep them in a covered area, watering every other day.

GERMINATION

- It may take from two weeks to three months for all viable seeds to sprout.
- Wait until four true leaves develop before transplanting into 2-inch pots with well-draining media mix.
- Keep transplanted seedlings in the shade for a month or so, then move them to a sunny area.

CUTTINGS

- Take softwood tip cuttings 3–4 inches long during the morning hours; keep them moist in a sealed plastic bag until starting.
- Remove the lower foliage and cut the top foliage in half.
- No rooting powders are necessary. Insert at least one to two nodes of each stem under the cutting mix in a shallow flat.
- Water the cuttings in and keep them in a shaded, covered area.
- In two to three months, pot up the rooted cuttings into 4-inch pots.

OUTPLANTING

- Your plants will be ready to outplant in six months, when the plants have outgrown a 4-inch pot.
- Choose an area in full to partial sun; amend the planting hole and soil as recommended.
- They are easy to grow and maintain in rock gardens, sandy soil, or as understory plants.
- In a few years, *Lepidium* will re-seed itself and will spread in your garden. What could be better than a native plant replacing the introduced weeds?

PESTS

- Watch for red spider mites, which can occur on the underside of the leaves, causing the plant to look sickly. Wash off the mites or spray them with horticultural oil.
- Control ants from the base of the plant by applying ant bait.

C

CAMPANULACEAE

(BELLFLOWER FAMILY)

GENUS:
Brighamia

HAWAIIAN NAMES:
Ālula; ʻŌlulu; Puaʻala

SPECIES	STATUS	HAWAIIAN RANGE
B. insignis	E	end (Ni, K)
B. rockii	E	end (Mo)

Partial Sun

Range
Hawaiian Endemic

Description
succulent

Propagation
seeds



Alula Limahule Gardens—KLR

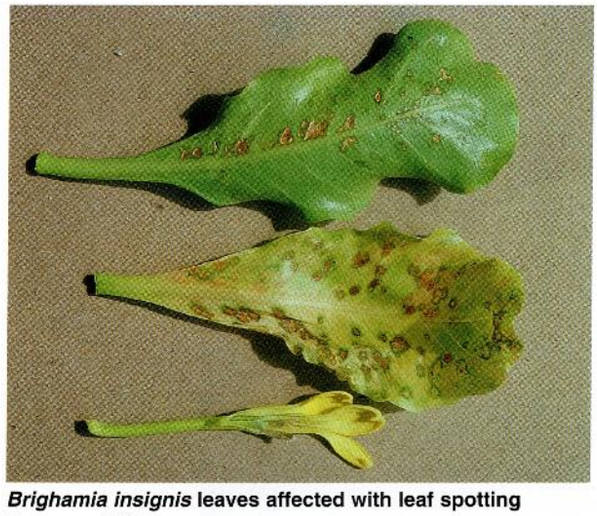
GENERAL DESCRIPTION

The two endemic *Brighamia* are very unusual, different from all of the other genera in Hawaiʻi. They have thick, succulent stems, stout at the base, which support this sometimes tall plant (3–15 feet). In most cases, the leaves form a single rosette at the top, but sometimes if the tip is damaged the plant will branch out, forming up to three or more rosettes. The leaf rosette consists of either large or small leaves depending on the amount of sun and moisture available to the plant. Fragrant long white to yellow flowers form in late summer within and just above the leaves. Seeds develop in green capsules in some cases all year long, splitting when they mature. Lines of latex form along the splits on the capsules, which can glue the seeds to insects or the feathers of birds. This is a dispersal mechanism and how they probably arrived.

The thick succulent stem holds water for times of drought; overwatering can easily rot and kill ālula. If the



***Brighamia rockii* flowers – Molokaʻi—SP**



***Brighamia insignis* leaves affected with leaf spotting fungus—MC**

stem starts to soften at the top or near the base; this indicates problems. Check the media at the base of the plant. If it is wet, stop watering because too much water has caused the stem to start to rot. If the soil is dry, continue to water, as the stem is soft because it has dried out. The plant may grow out of this stage of decline; too much water can also cause fungal infection on the foliage indicated by brownish-yellow spots on the leaves. The infected leaves should be removed and destroyed. Goats are a major threat to ālula in the wild because they feast on the succulent stem, which is the reason why only plants isolated on steep cliffs survive today, and most of their seeds fall into the ocean below.

Fortunately, these are very easy to grow in cultivation. In fact, they have become quite popular with succulent plant enthusiasts nationally and internationally. Seeds distributed from Hawai'i in the 1970s were recently traced and their progeny were found in many botanic gardens and private gardens around the world. I have seen *Brighamia* growing in a botanic garden in Switzerland. Treat the ālula like a succulent; giving it partial sun, a well-aerated soil mix, a little water, and lots of tender loving care.

Entire Range: Hawaiian endemic

Wild Habitat: Sea cliffs, windward cliffs 0–470 m elevation

Habit: Succulent, solitary or branched stem with rosette of leaves at apex

Mature Height: 1–5 m

Stem/Trunk: Solitary to branched succulent 1–5 m tall. Stout stems, fleshy, thickened toward the base, glabrous (smooth), the stem is not truly woody; it is soft

Leaves: Simple, arranged in a dense apical rosette; fleshy, obovate (inversely ovate), margins entire, slightly toothed, sessile (attached without a stalk) to subsessile

Inflorescence/Flower: Fragrant, three to eight in suberect to horizontal racemes; corolla white or yellow, the tube slender, straight, entire at anthesis, ovary inferior, two-celled; each cell dehiscent by two lateral slits

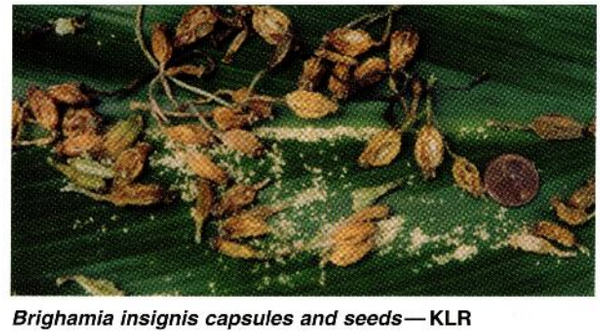
Fruit: Capsules 13–20 mm long and 4–10 mm wide

Seed: The seeds are very tiny, numerous, pale, and ovoid (Wagner et al. 1990)

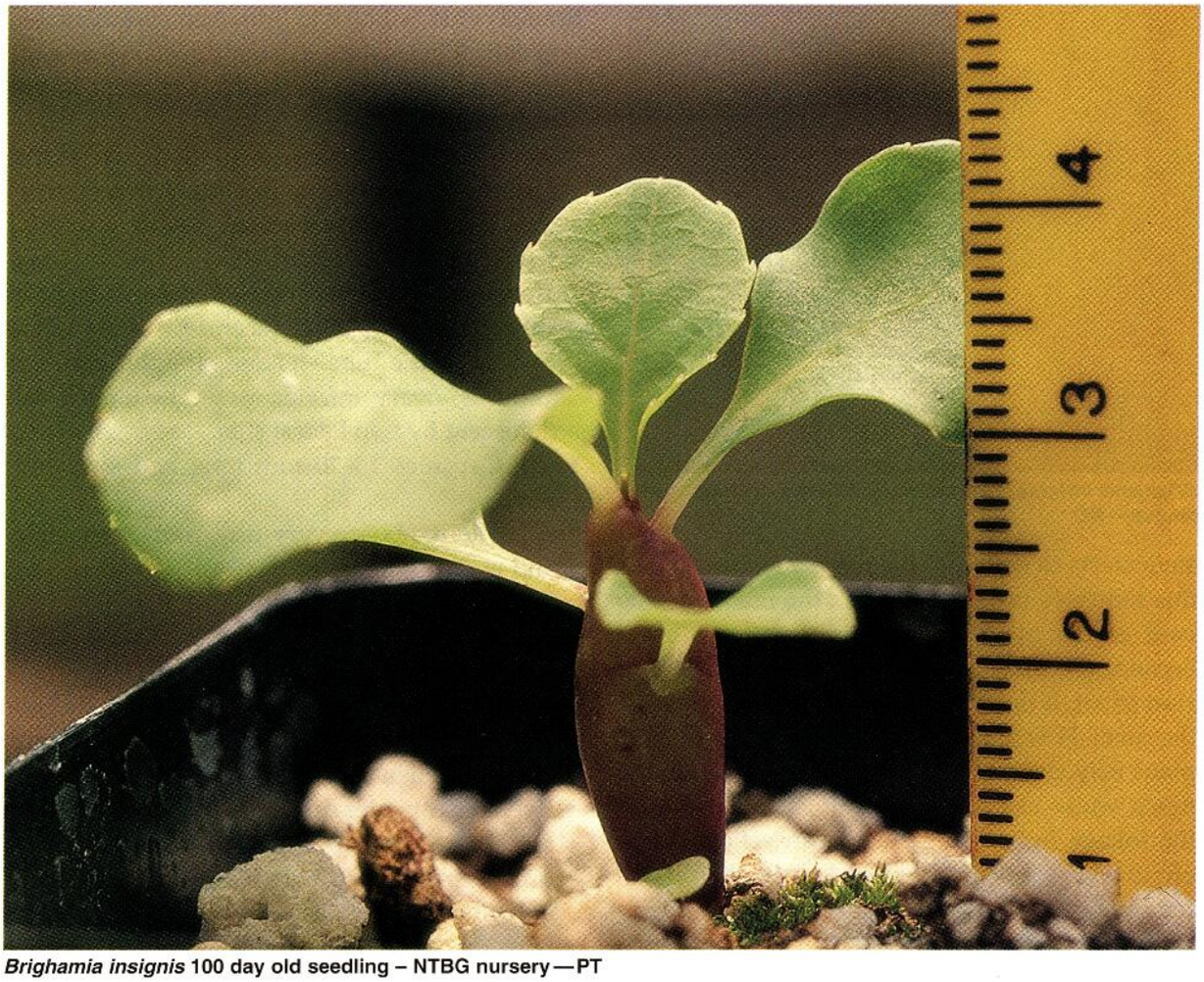
PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect mature capsules when the latex is present along the splits on the swollen capsules.
- Keep the capsules dry in a paper bag until they are cleaned. Remove the small seeds by ripping capsules apart above a bowl; this will help avoid losing any seeds.
- Sow the seeds fresh for best results. Do not desiccate them (they will lose their viability), but they can be stored dry in the refrigerator up to a year.
- No pretreatments are necessary; surface sow the small seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1); or use 3 parts fine black cinder to 1 part potting mix (3:1).
- Water the seeds in, and keep them in a covered, protected area; watch for slugs, which like to eat the seedlings.



***Brighamia insignis* capsules and seeds—KLR**



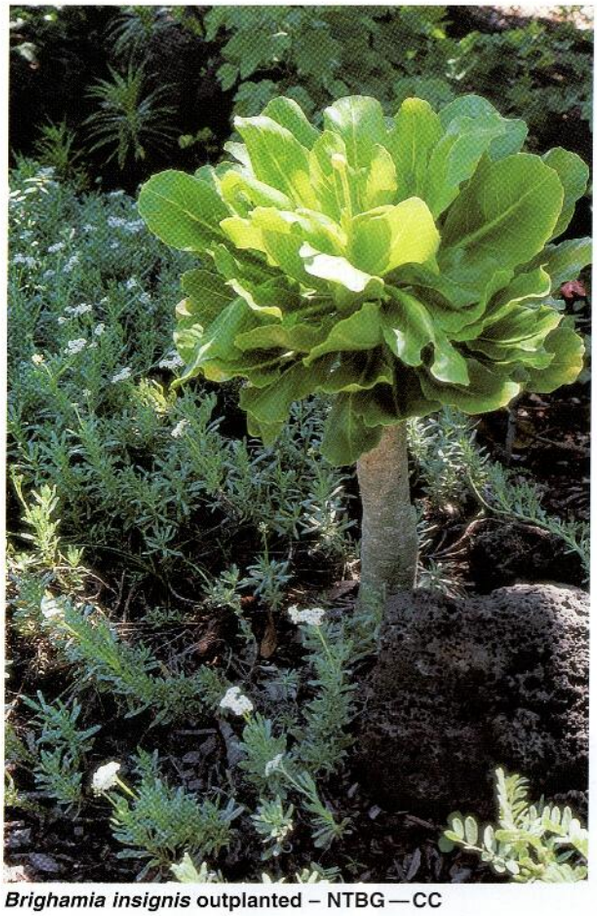
***Brighamia insignis* 100 day old seedling – NTBG nursery—PT**

GERMINATION

- Germination begins in ten days. They will start to develop into tiny sprouts, and in another three months all of the viable seeds will have germinated.
- Foliar feed the seedlings monthly with a light solution. Transplant them into 1–2-inch pots when they are only ½ inch tall.
- It is important that the transplant mix is free-draining; use 3 parts fine black cinder to 1 part potting mix (3:1) with a small amount of 8-8-8 NPK fertilizer mixed in; or 3 parts perlite to 1 part potting mix (3:1).
- Keep potted seedlings in a shaded area for two to three months. Maintain on the dry side, watering twice a week or when dry. It is important not to disturb the roots; pot them with care
- Repot them into 4-inch pots in two to three months, then repot them every six months using new media and larger pots. Cement or clay pots are recommended to help keep the soil on the dry side, a mix of 3 parts black cinder to 1 part potting mix (3:1) with small amounts of 8-8-8 NPK fertilizer mixed in is recommended.



***Brighamia insignis* F1 seeding – NTBG nursery—KLR**



***Brighamia insignis* outplanted – NTBG—CC**

OUTPLANTING

- In general, *B. rockii* is harder to keep alive in cultivation. It seems to be weaker and more susceptible to various pests, diseases, and other potential problems.
- *B. rockii* is ready for outplanting in two years; *B. insignis* may be ready in one year.
- *B. insignis* and *B. rockii* will tolerate partial sun, doing best on the northeast side of a building or yard.
- Some of the best sites for planting this remarkable but sensitive plant include black cinder rock gardens or in mounds of cinder reinforced with large rocks.
- Be careful not to bruise the soft stem; a bad bruise can cause rotting to set in, and, eventually, death. Use a fungicide to treat any wounds in the stem if they occur from slugs or other pests.
- *Brighamia* does well as a container plant if it is transplanted into larger pots when needed.

PESTS

- Ālula has two major pests: slugs, which can be managed using slug bait; red spider mites, which can be managed using horticultural oils.
- Slugs can even kill large plants by eating holes into their succulent stems, which succumb to fungal rot; if this happens, treat the holes in the stem with a fungicide.
- Red spider mites live on the underside of leaves, turning the leaves yellow. If left untreated, the leaves will fall off and weaken the plant. Wash off the mites by hand for small outbreaks.



Slug on Alula—KLR

C

CAMPANULACEAE

(BELLFLOWER FAMILY)

Full Sun – Partial Sun[1]

Range
Hawaiian Endemic

Description
herbs, shrubs or trees[2]

Propagation
seeds and cuttings

1: Sun requirements differ for each genus and species.

2: Description differs for each genus and species.

GENUS:
Clermontia

HAWAIIAN NAMES:
ʻŌhā wai; ʻōhā, hāhā

SPECIES	HABITAT
Thirty one endemic species	bogs, mesic and wet forests

GENUS:
Cyanea

HAWAIIAN NAMES:
ʻAkū; pua kala; hāhā lua; hāhā

SPECIES	HABITAT
Eighty five endemic spp.	bogs, mesic and wet forests

GENUS:
Delissea

SPECIES	HABITAT
Sixteen endemic spp. seven extinct spp.	diverse mesic forest

GENUS:
Lobelia

HAWAIIAN NAMES:
Pānaunau; puʻe; liua; ʻōpelu

SPECIES	HABITAT
Seventeen endemic spp	diverse mesic forest

GENUS:
Rollandia
Merged into *Cyanea* (based on molecular data) (Lammers et al 1993)

GENUS:
Trematolobelia

HAWAIIAN NAME:
Koliʻi

SPECIES	HABITAT
Eight endemic spp.	bogs and wet forests



***Clermontia lindseyana*-flowers & fruit – Hawaiʻi—SP**



***Cyanea st.-johnii* flowering – Oʻahu—SP**



***Delissea rivularis* flowers – Kauaʻi—SP**



***Lobelia gloria-montis* habitat – Maui—SP**



***Cyanea* sp. flowers – O'ahu—KRW**



***Trematolobelia kauaiensis* and *'i'iwi* bird—JD**



***Cyanea pinnatifida* micro propagated by Lyon arboretum – NTBG nursery—KLR**

The remaining genera in this family do not exactly resemble each other, but they do share the same requirements for propagation and maintenance.

GENERAL DESCRIPTION

These genera are endangered and live as understory plants in isolated niches; sometimes inbreeding weakens the plants and the resulting seeds. The viability of the plants and seeds is always an issue with these genera if you are trying to propagate them in cultivation. In vitro micropropagation has worked very well in growing many of these endangered sensitive species such as *Cyanea pinnatifida*. For the more endangered species, with only one or two plants left in the wild, this method will be the only hope for preserving and cultivating them, although they are genetically identical when cloned. These endangered plants produce very weak, and sometimes aborted, seeds. It is not ethical or worthwhile to take cuttings from the last plant or last population left in the wild. The cuttings from a weak parent are also weak and will probably not root. More common taxa, such as *Cyanea fauriei*, are easy to grow in the right setting.

Entire Range: Hawaiian endemics

Wild Habitat: Bogs, wet forests, diverse mesic forests, mesic forests

Habit: Herbs, shrubs, or trees

Mature Height: 0.3–14 m

Stem/Trunk: Solitary to branched, unarmed, usually with milky sap

Leaves: Simple, alternate, entire, toothed, rarely pinnately lobed or partly compound, stipules absent

Inflorescence/Flower: Flowers perfect (rarely unisexual), flower parts in multiples of five, inferior ovary

Fruit: Berry or capsule

Seed: Numerous, small seeds with an oily endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- *Lobelia* and *Trematolobelia* seeds are in dry capsules, clean them as you would *Brighamia* seeds (dry small seeds).
- To propagate by seeds, first collect pulpy berries in early spring when they are soft and have changed in color from green to either yellow, orange, red, or purple: *Clermontia, Cyanea,* and *Delissea*.



***Trematolobelia* seed capsules—JO**

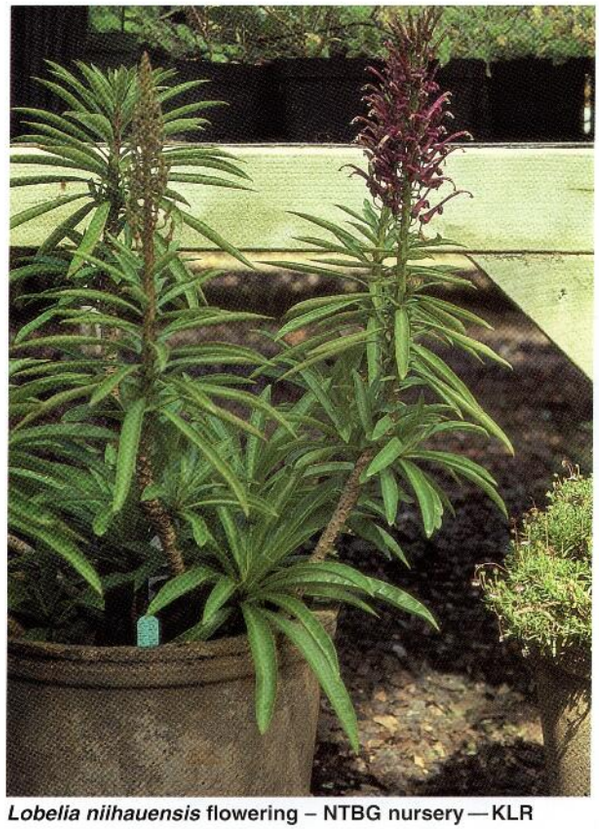
- Keep these pulpy fruits soft in a plastic bag for easy removal.
- Separate the tiny seeds from the berries as directed for small pulpy seeds. It is best to not store these seeds; they have higher germination rates if started fresh. They do tolerate refrigeration for a few months.
- For the species from wet forests, surface sow the small seeds onto moist sphagnum moss or fine black cinder and place the flat under or in a mist system.
- For the species from drier mesic forests, surface sow the seeds onto 2 parts perlite to 1 part potting mix (2:1) or 3 parts black cinder to 1 part potting mix (3:1) and keep them moist in a covered, shaded, protected area.
- Do not let the seed flats dry out at any time before or after germination.

GERMINATION

- Expect germination in one to six months for all viable seeds to sprout; the mesic source species are hardier.
- Wait until the small seedlings have four to six true leaves before handling; this may sometimes take six months to a year, as they are very sensitive.
- Transplant them into 2-inch pots in moist, well-draining mix such as 1 part cinder to 1 part potting mix (1:1).
- Keep them in a covered, shaded area, repotting every six months into larger and wider pots and adding new, well-draining mix.
- These taxa can be sensitive to the chlorine and chemicals added to municipal tap water. When this is the case, white crust can form on the leaves. It is best to use pure rainwater.



***Delissea rivularis* seedlings – NTBG nursery—DR**



***Lobelia niihauensis* flowering – NTBG nursery — KLR**

- Fertilize them with a foliar feed and amend the media with an 8-8-8 NPK fertilizer, the same as for *Brighamia*.

OUTPLANTING

- Choose a site in full to partial shade with moist, well-draining soil, and at higher altitudes, if possible 300 ft or greater.
- In general, the mesic species grow better at lower elevations than the wet forest and bog source species.
- These plants usually grow as understory plants in the wild, so plant them under trees, protected by shrubs and among ferns for their maximum growth and survival.



***Clermontia arborescens* subsp. *waihiae* fruit – Maui — F&KS**

- Dig the hole as deep as the pot, but wider, giving the shallow roots room to grow straight out into well-amended soil; for better drainage, add black cinder as a soil amendment.
- Water in the plants well, then water them weekly when they become dry, and monitor your plants closely, checking for soil moisture and pests.
- Adding prepared polymer to the soil is ideal with these species and would require less watering.

PESTS

- Many pests afflict the species within Campanulaceae such as slugs, ants, red spider mites, aphids, rats; the list goes on. Control each of these as recommended. Early pest detection and control helps the plants. If the plants can stay healthy and strong, it is easier for them to resist pests and diseases.
- Their major threats in the wild are the goats, which graze on these plants, and rats, which eat the seeds and the plant stems and the bark off of plant stems and branches.

CAPPARACEAE

(CAPER FAMILY)

GENUS:

Capparis

SPECIES	STATUS	HAWAIIAN RANGE
C. sandwichiana	V	end (HI)

HAWAIIAN NAMES:

Maiapilo; pilo; pua pilo

COMMON NAME:

Caper bush

Full Sun

Range
Hawaiian Endemic

Description
sprawling shrub

Propagation
seeds



***Capparis sandwichiana* flowers – Maui — HB**

GENERAL DESCRIPTION

Capparis is a low spreading shrub, growing on coral ledges, rocky cliffs, or lava flows near the shore. The attractive fragrant flowers have four white petals that surround a mass of stamens; open after sunset, turning pink with age. The long, foul-smelling berries turn orange and soft when ripe, and each contains ten to fifteen round seeds. Since this plant produces an abundance of viable seeds it is best to grow it from seeds, thus reducing the taking of unnecessary cuttings from the wild. *Capparis* makes a good ground cover for a dry, coastal or lava garden planting.

Entire Range: Hawaiian endemic
Wild Habitat: Coastal, grows on coral, basaltic rocks, or in coastal soils
Habit: Climbing or sprawling shrubs, rarely small trees
Mature Height: 1–5 m long
Stem/Trunk: Branching, decumbent (growing along ground) or prostrate
Leaves: Simple, alternate, margins entire, stipules reduced to spines or absent

Inflorescence/Flower: Flowers perfect, four sepals, open after sunset, four white petals turning pink with age, densely pilose (covered with soft hairs); about 180 white stamens that turn pink with age

Fruit: Orange berries, ellipsoid, 4–5 cm long and 1.7–3 cm in diameter; mesocarp very foul-smelling

Seed: Seeds are one to numerous, dark reddish-brown to gray, embedded in foetid orange pulp (Wagner et al. 1990)



***C. sandwichiana* ripe fruit with seeds—F&KS**

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect berries when ripe, orange, and soft; keep soft in a plastic bag for easy cleaning.
- Separate the pulp from reddish-brown seeds, as recommended for small pulpy seeds.
- The seeds can be stored for up to six years in desiccation, or in the refrigerator.
- For faster germination, soak the seeds in tap water for three to five days because they have hard seed coats.
- Sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1) in a shallow flat, and then add ½ inch of mix on top of the seeds.
- Water the flats and every other day; keep them in a protected, covered area and on the dry side.

GERMINATION

- Germination takes two weeks to three months for all of the viable seeds to sprout.
- Wait until the seedlings have at least four true leaves before transplanting into 2-inch pots.
- Your transplant mix must be well-draining, use 3 parts black cinder to 1 part potting mix (3:1) with a small amount of 8-8-8 NPK fertilizer.
- Repot them into 4-inch pots in two to three months.

OUTPLANTING (fast-growing)

- Outplant in six months, when your plant has outgrown a 4–6-inch pot.
- Choose a site in full sun and use a well-draining soil; amend with cinder or small gravel.
- Water them in at first, and then water weekly for a month; this is a low-maintenance plant.
- This plant tolerates trimming or pruning.
- Give *Capparis* plenty of room to spread out, 6 feet or so.
- Irrigation is not needed; too much watering can rot the stem and kill the plant.

PESTS

- Coffee twig borers attack the stems of this plant. Cut off the affected stems and discard them. Control them with a systemic pesticide.
- Rats feed on the seeds and seedlings, use traps to control them.
- If ants are observed at the base of the plant; control them with the ant bait protocol.
- Powdery mildew can afflict the caper; it appears as white spots on the leaves and is the result of too much water. Treat with a fungicide and reduce watering, *Capparis* needs to be grown in a well-draining soil.

CARYOPHYLLACEAE

(PINK FAMILY)

GENUS:

Alsinidendron

Merged into *Schieda* (Wagner et al 2005)

HAWAIIAN NAME:

Kuawāwaenohu

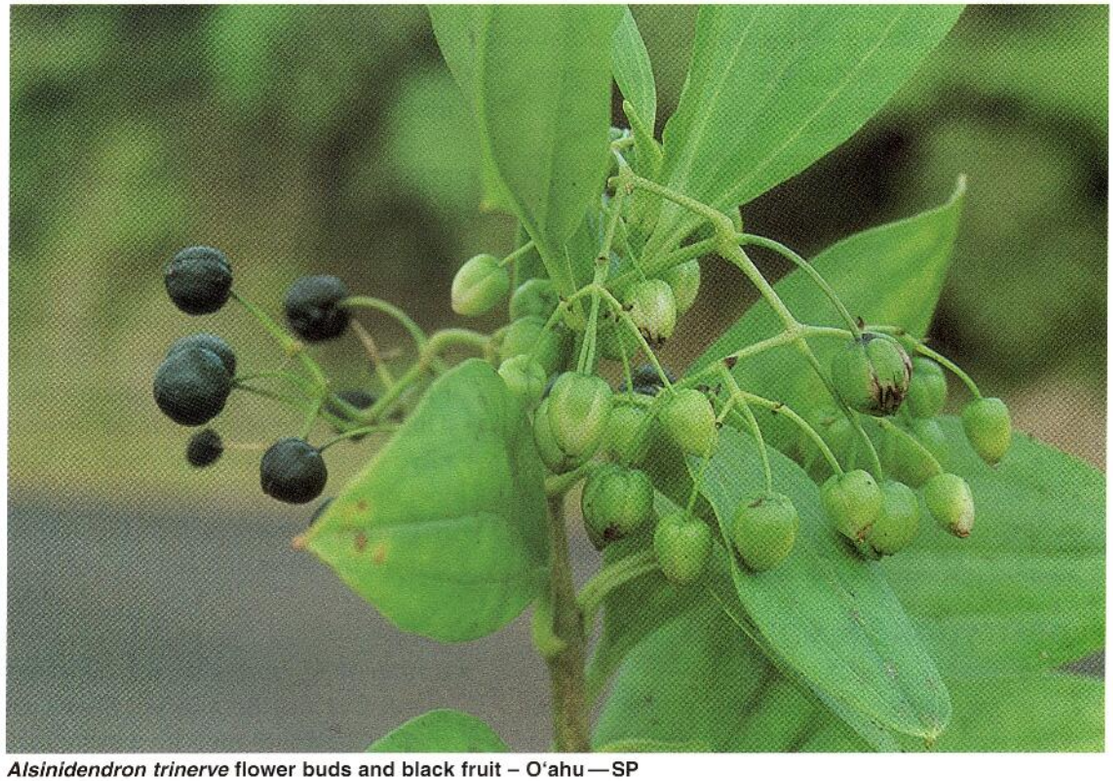
SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. lychoides	R	end (K) wet forests
A. obovatum	E	end (O) diverse mesic forest
A. trinerve	E	end (O) wet forests
A. viscosum	Ex	end (K) diverse to wet forests

Shady

Range
Hawaiian Endemic

Description
upright or sprawling subshrub

Propagation
seeds and cuttings



***Alsinidendron trinerve* flower buds and black fruit – O'ahu—SP**

GENERAL DESCRIPTION

The genus *Alsinidendron* has been merged into *Schieda* (Wagner et al. 2005). I will keep *Alsinidendron* information here, for when they decide to change it back. Kuawawaenohu occur either on Kaua'i or O'ahu and are divided into two groups. *A. obovatum* and *A. trinerve* are thin green upright subshrubs with fleshy, thick leaves, and purple flower parts. When mature, they are very rarely found scattered on ridges and slopes in mesic to wet areas of O'ahu. The seeds, which are in dry capsules, take on a berry like appearance excreting a purplish-black substance to attract birds that disperse their small round dark seeds.

A. lychnoides and *A. viscosum* occur as woody climbing or sprawling subshrubs with thin flexible leaves and green flower parts at maturity, occurring in wetter forests on Kaua'i. I had these species germinating and growing in the NTBG nursery near sea level. They did fine until the heat of the summer set in. Then they would weaken, and sometimes died. However, this did not happen at the mid-elevation nursery in Kōke'e (3,000 ft) where they grew and tolerated outplanting very well. They do best growing at higher, cooler altitudes or in a cool room.

Entire Range: Hawaiian endemic

Wild Habitat: Wet forests, diverse mesic forests
Habit: Erect subshrubs or vines
Mature Height: 3–30 dm
Stem/Trunk: Stems woody at the base, either glabrous (smooth) or with minute hairs
Leaves: Leaves opposite, palmately three-nerved or five-nerved, margins entire, petiolate, and stipules absent
Inflorescence/Flower: Sepals white or the outer pair green, distinct, not forming a tube; stamens connate (united) at base, four to eleven styles, flowers in axillary, compound cymes formed by the development of lateral shoots
Fruit: Ovoid to subglobose capsules
Seed: Seeds black, 1–1.5 mm long (Wagner et al. 1990)


***A. lychnoides* flowering – Kaua'i—SP**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the dry capsules and keep them dry in a paper bag; the capsules split open when ripe and dry.
- Separate the small black seeds from the capsules as directed for small dry seeds.
- The seeds can be stored in desiccation chambers or refrigerated for up to eight years.
- Soak the seeds in tap water for one hour. Seeds will sprout without soaking, but they may take one to two months longer.
- Surface sow the seeds on a dry mix such as 3 parts perlite to 1 part potting mix (3:1); water them in, then water every other day.
- Keep them moist in a shaded, covered area.


***A. lychnoides* seed capsules—SP**

GERMINATION

- Allow one to three months for all of the viable seeds to sprout, and then wait until four true leaves develop before transplanting into 2-inch pots.
- Use a well-draining mix made up of 3 parts cinder to 1 part potting mix (3:1) or 3 parts perlite to 1 part potting mix (3:1) adding a small amount of 8-8-8 NPK fertilizer.
- Keep seedlings in a shaded, protected area; they are delicate plants and require watering every other day or when dry.
- Repot every six months or so into larger pots with new soil.

CUTTINGS

- Cuttings can be started from green, cultivated plant-tip cuttings, but it is not recommended to collect material from the wild because these plants are too endangered, weak, and sickly.
- Apply rooting powder No. 1 to the base of the cutting, and cut the foliage in half.
- Place the cuttings in a mix of 3 parts perlite to 1 part potting mix (3:1), and in a mist system for best results.
- Allow three to four months for root development, then transplant into 2–3-inch pots.
- Treat them similar to the transplanted seedlings. Do not allow them to dry out at any time.

OUTPLANTING

- Unless you have a cool, shady site in a well-draining rocky soil, keep these plants in pots, repotting every six months to a year and changing the media. Handle these sensitive plants with care; the stems break easily.
- Outplant them with other plants such as trees, shrubs, and ferns for added protection.
- Polymer is recommended for wet forest species.

PESTS

- Use a systemic pesticide (such as a soil drench) to control aphids, thrips, scales, and root mealybugs.
- **Note**: These species are sensitive to many chemicals.

C

CARYOPHYLLACEAE

(PINK FAMILY)

GENUS: *Schiedea*		
SPECIES	STATUS	HAWAIIAN RANGE
Thirty five endemic species	AS, R, V, E, Ex	(HI)

GENUS: *Silene*		COMMON NAME: Catchfly
SPECIES	STATUS	HAWAIIAN RANGE
Seven endemic species	AS, R, E, Ex	(HI)

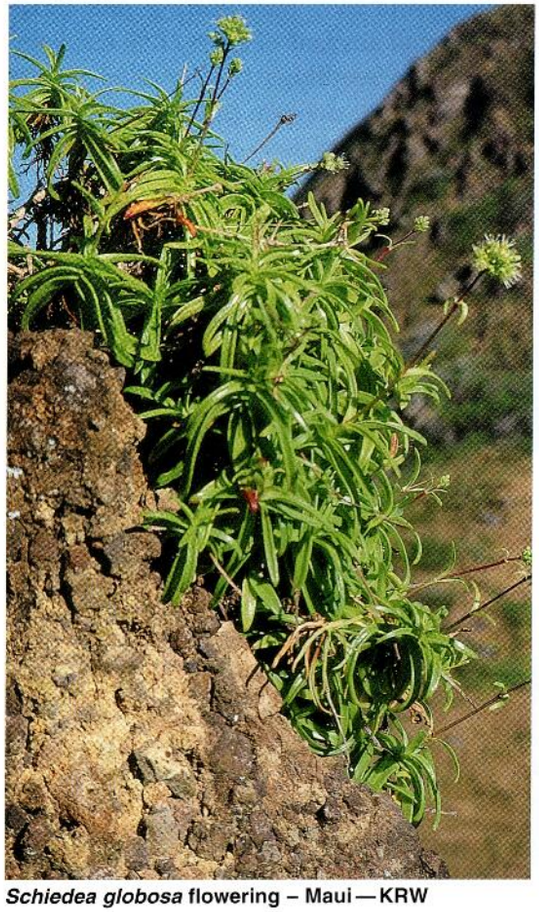
Shady–Full Sun[1]

Range
Hawaiian Endemic

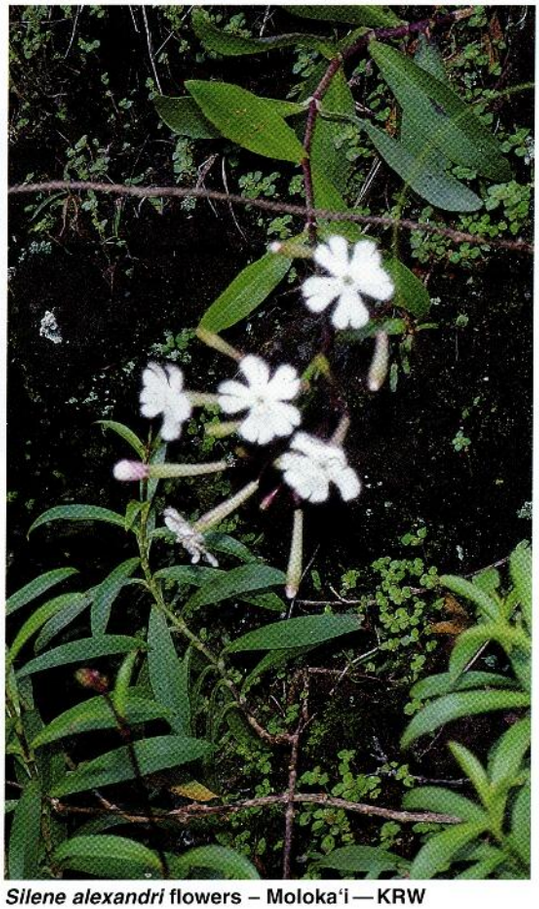
Description
erect to sprawling subshrub

Propagation
seeds and cuttings

1: Sun requirements are species specific.



***Schiedea globosa* flowering – Maui—KRW**



***Silene alexandri* flowers – Moloka'i—KRW**

GENERAL DESCRIPTION

The Hawaiian Caryophyllaceae are small, erect to sprawling subshrubs. Many *Schiedea* species and *Silene* species are threatened with endangerment or extinction in the wild because of habitat destruction and four-legged browsing animals. Both genera are found on all the main islands from the coast to the alpine zones. Their tiny seeds are easily dispersed by birds. These genera are easy to grow and maintain in the nursery and when outplanted, and they are not as sensitive as the *Alsinidendron*. Different species of *Schiedea* will cross readily producing hybrids from the seed if kept in close proximity to each other when flowering. They make a nice ground cover when planted in the proper habitat, which is species specific.

Entire Range: Hawaiian endemic
Wild Habitat: Coastal to alpine
Habit: Erect to sprawling subshrubs
Mature Height: Ranging from 0.2–100 dm tall/long
Stem/Trunk: Herbaceous or woody



Schiedea cf. *hillebrandii* habitat – Moloka'i—SP



Schiedea apokremnos flowers – Kaua'i—SP

Leaves: May be fleshy, opposite or usually whorled leaves, sometimes subulate (awl-shaped tapering from base to apex)

Inflorescence/Flower: Flowers perfect or unisexual, in multiples of five, usually in paniculate cymes

Fruit: Capsules

Seed: Tiny, dark, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the small capsules at the branch ends; keep them dry in a paper bag.
- Separate the seeds as directed for small dry seeds.
- These seeds can be stored in a desiccation chamber for up to eight years or kept dry in refrigeration.
- For faster germination, soak the seeds in tap water for one hour.
- Surface sow the small brownish seeds on a dry mix made up of 3 parts perlite to 1 part potting mix (3:1).
- Water the seeds in, then water every other day.
- Keep the flats in a shaded, covered area.

GERMINATION

- It may take three weeks to three months for all viable seeds to sprout.
- Look for the development of four to six true leaves.
- Transplant them into 2-inch pots with well-draining transplant mix.
- Keep the seedlings in a shaded, protected area, then move them to partial shade.
- Repot them every six to eight months in larger pots using new soil.

CUTTINGS (easy)

- Collect stem cuttings with at least three nodes; reduce the lower foliage.
- Keep the cuttings moist in a sealed plastic bag, out of direct sunlight until it is time to start them.
- Section the cuttings into 3-inch pieces and apply rooting powder No. 1 to the woody portions near the base of the cutting, and no rooting powder to the green stems.
- Stick one to two bottom nodes under a mix made up of 3 parts perlite to 1 part potting mix (3:1); water lightly so not to wash off the rooting powder.
- Then water every other day until they are rooted in two to four months, depending on the health of the parent plant at the time the cuttings were taken.
- Transplant them and care for them the same as you would the seedlings.

OUTPLANTING

- They will be ready for outplanting in six months to a year, or when they have outgrown a 6-inch to 1-gallon pot.
- For best growth results, outplant them into a shady area with a well-draining soil, and amend the soil if it is not well-draining.
- Plant them as an understory plant by surrounding them with trees, shrubs, and ferns for added protection.
- Water them in, then water weekly for a few months depending on the rainfall, then water only during extended periods of drought.
- Fertilize every six months to a year with a liquid foliar feed or 8-8-8 NPK fertilizer.

PESTS

- Slugs can be pests; they eat the stems and foliage. To manage them, apply slug bait as recommended.
- Root mealybugs, aphids, thrips, and red spider mites can also attack the plant. When they do, use a systemic or horticultural oil to control them.

C

CELASTRACEAE

(BITTERSWEET FAMILY)

GENUS:

Perrottetia

SPECIES	STATUS	HAWAIIAN RANGE
P. sandwicensis	—	end (HI exc. Ni, Ka)

HAWAIIAN NAMES:

Olomea; pua'a olomea; waimea

Partial Sun

Range
Hawaiian Endemic

Description
shrub or small tree

Propagation
seeds



Perrottetia sandwicensis – Kaua'i — DR

GENERAL DESCRIPTION

The early Hawaiians used the wood of the common olomea, along with hau, to start fires. In the late summer to autumn, the tiny round red fruits develop in dense clusters and contain two to four dark seeds that are covered with a mucous that becomes slimy when wet. This is the seed's dispersal mechanism, attaching themselves to birds. This plant can easily self-pollinate, producing many viable seeds.

Entire Range: Hawaiian endemic

Wild Habitat: A common understory tree in wet forests from 300–1,830 ft (91–558 m) elevation.

Habit: Shrub or small tree

Mature Height: 2–8 m height

Stem/Trunk: Branches red to green, short and stiff, at higher elevations long, drooping, and glabrate (without hairs or glands)

Leaves: The leaves are large dark green, alternate, and glossy with finely toothed edges and red petioles, midribs, and pinnate veins. The new foliage is also bright red in color.

Inflorescence/Flower: Flowers in paniculate cymes, near the branch ends, each flower is small, greenish-red, and polygamodioecious (having both perfect and male or female flowers on the same individual plant)



***Perrottetia sandwicensis* seeds – Kaua'i — DR**

Fruit: Depressed-globose (more or less spherical and flattened endwise), bright red berries, 2–6 mm in diameter

Seed: Seeds two to four, triangular-globose, about 1.5 mm long, the seed coat thick, crustaceous, with transverse ridges (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the small fruits when they are bright red; keep them moist in a plastic bag.
- Separate the very slimy pulp from the seeds, as directed for pulpy small seeds.
- No pretreatments are necessary; surface sow the seeds in a flat on a mix of 3 parts perlite to 1 part potting mix (3:1).
- Keep them in a shaded, covered, and protected area.
- Once the seedlings emerge, foliar feed them monthly with a light foliar solution.

GERMINATION (slow-growing)

- Germination can take two weeks to three months for all viable seeds to sprout. This species has high germination rates.
- When at least four true leaves develop they are ready to be transplanted; this is usually in two months' time.
- Use a well-draining mix and transplant into 4–5-inch pots.
- Keep them in the shade and repot them into deeper pots every six months and add new, well-draining mix each time.
- Move them to partial sun to help harden them off for outplanting.
- Foliar feed them every month; olomea is sensitive to insecticides and also does not respond well to mix that drains poorly.

OUTPLANTING

- The olomea may take two years before it is ready for outplanting; watch for when it has outgrown a 2–3-gallon pot.
- Choose a site in that is in partial sun, and out of strong wind, with a healthy well-draining soil.
- Dig and amend a hole as directed, as the olomea is worth the extra care.
- Water the plant(s) in, then water weekly until the plant is growing healthy and new foliage develops.
- Fertilize every six months or foliar feed your olomea monthly.

PESTS

- The most common pests of olomea are ants found in the pot at the base of the plant and in the ground. To control them, use the ant bait as directed.

CHENOPODIACEAE

(GOOSEFOOT FAMILY)

GENUS:

Chenopodium

HAWAIIAN NAMES:

ʻĀweoweo; ʻāheahea

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
C. oahuense	—	end (KL, HI) coastal to sub-alpine shrublands

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
small tree

Propagation
seeds and cuttings

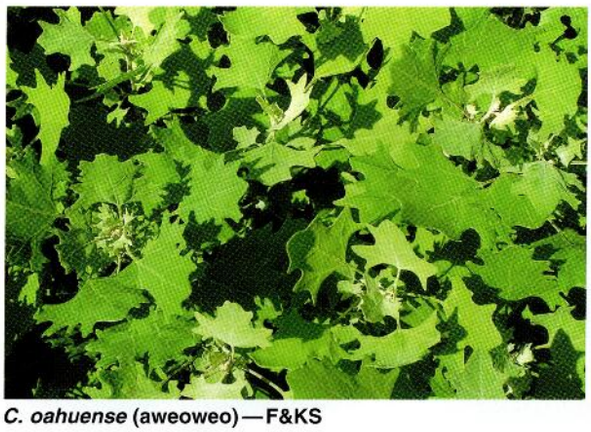


***Chenopodium oahuense* flowers and seeds – Hawai'i — DL**

GENERAL DESCRIPTION

ʻĀheahea grows as a weedy, low, drooping shrub in dry coastal areas or as a small upright tree 12–15 feet tall in higher dry elevations. It is the woodiest *Chenopodium* in the world (most are fleshy annual herbs). The thick, fleshy leaves are as long as they are wide, are somewhat triangular in shape, and are covered with tiny woolly hairs, giving the whole plant a greenish-gray appearance. The many tiny flowers are densely clustered at the branch ends on spiked stems above the foliage, and contain small dark brown seeds that are easy to grow and the plant is easily maintained in the landscape. They can potentially become weedy. Potting up the unwanted seedlings and giving them away to others is a good way to share and teach about native plants.

Entire Range: Hawaiian endemic to all of the main Hawaiian Islands and Lisianski, Laysan, French Frigate Shoals, Necker, and Nihoa (not Kaho'olawe)



C. oahuense (aweoweo)—F&KS

Wild Habitat: Occasional to common in dry habitats including coastal, dry forest, and subalpine shrubland

Habit: A scentless to weakly scented shrub, sometimes tree-like

Mature Height: 5–30 dm long; 4–5 m

Stem/Trunk: Stems erect, ascending or prostrate; usually densely grayish, mealy pubescent (bearing hairs), sometimes young growth greener

Leaves: Leaves are simple, alternate, thick, and fleshy with both surfaces densely, mealy pubescent, with the upper surface greener; three-lobed, if the leaf margins are toothed; they are rounded with the leaf base cuneate (wedge-shaped); petioles 1–2.5 cm long

Inflorescence/Flower: Flowers are perfect, bractless, in multiples of five, and in terminal clustered panicles

Fruit: Fruit is a utricle

Seed: The seeds are dark brown, horizontal, about 0.8 mm in diameter, with a papillose (covered with short, rounded, blunt projections) surface and indistinct margins (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the small fruits when they are dry, brown, and shedding from the branches early in the year.
- Keep them dry in a paper bag until they can be cleaned as directed for small dry seeds.
- The seeds can be stored in a desiccation chamber for two years or more, or in the refrigerator.
- Surface sow the small seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1), and then water in.
- Keep the flat in a covered area, watering every other day.

GERMINATION

- It will take two weeks to three months for all viable seeds to sprout.
- Transplant them into 2–3-inch pots after at least four true leaves develop.
- Keep the seedlings in a shaded area for two weeks, and then move them into full sun to help harden them off.

CUTTINGS (easy)

- Collect soft to semi-hardwood cuttings in the spring about 3–4 inches long.
- Remove the lower foliage and cut the top leaves in half, keep the cuttings moist in a sealed plastic bag.
- No rooting powders are needed; insert at least one node into the moistened mix of 3 parts perlite to 1 part potting mix (3:1).
- *Chenopodium* will root in about two months; when they do, pot them into 2- to 4-inch pots using a well-draining soil mix, as recommended.
- Keep them in a shaded, protected area for three weeks, and then move them into a sunnier area to harden them off.

OUTPLANTING

- *Chenopodium* will be ready for outplanting in six to eight months or when they have outgrown a 4–6-inch pot; when this happens outplant them into a well-draining soil, and amend the area as directed.
- ʻĀheahea is a hardy plant and likes full sun to partial shade. In the wild, it grows in drier habitats from sea level to subalpine shrubland.
- Water it in at first, then water during times of prolonged drought.

PESTS

- The biggest pests are ants found in the pot or at the base of the plant and in the ground. To control them, use the ant bait as directed.

C

CONVOLVUACEAE

(MORNING GLORY FAMILY)

GENUS:
Bonamia

SPECIES	STATUS	HAWAIIAN RANGE
B. menziesii	E	end (HI exc. Ni, Ka)



***Bonamia menziesii* flowers – Maui—SP**

Partial Sun

Range
Hawaiian Endemic

Description
woody vine or ground cover

Propagation
seeds and cuttings

GENERAL DESCRIPTION

Bonamia is a liana (woody vine) with leathery leaves that are covered with a soft, yellowish-brown fuzz that becomes smooth on the upper surface, remaining fuzzy on the lower surface, as they mature. This is one of the plant's most attractive features. The singular, white-green flowers are funnel-shaped and are borne from leaf axils, giving way to hanging yellowish-brown capsules that contain one to two brownish-black seeds. *Bonamia* is increasingly threatened because of habitat destruction.

Entire Range: Hawaiian endemic

Wild Habitat: Dry to mesic forest, rarely in wet forests, found on all of the main Hawaiian Islands except Ni'ihau and Kaho'olawe

Habit: A fast-growing climbing liana (woody vine)

Mature Height: 10 m long

Stem/Trunk: Liana with twining stems, lateral branches covered with a yellowish-brown tomentose when young, becoming glabrous with maturity

Leaves: Leaves are entire, soft and leathery, glabrous to tomentose on the upper surface, the lower surface has a dense covering of yellowish-brown tomentum (hairs); oblong-elliptic, 3–8 cm long and 1–4 cm wide

Inflorescence/Flower: Solitary flowers or in cymes, petioles (stalks) 1–2 cm long; 2 scale-like bracts at the base of the soft-leathery yellowish-brown sepals, which embrace the white or greenish-white petals, covered with hirsute brown hairs in five bands; flower five-merous

Fruit: Capsules that are tan to yellowish-brown, pendent, papery, and ovoid-conical, 20 mm by 15 mm

Seed: Seeds are covered with a soft brownish-black film or pulp over the ovoid seeds, 7 mm by 5 mm. Once the film is removed, the seeds are tan (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the capsules when they are dry, brown, and shedding from the vine; keep them dry in a paper bag.
- Remove the small seeds from the capsules by hand.
- Start the seeds fresh for the best germination results. They do not tolerate desiccation storage and will lose their viability, but will tolerate refrigeration.
- No treatments are needed; sow the seeds in a mix of 3 parts perlite to 1 part potting mix (3:1) and cover with a ½ inch layer of the mix.
- Keep the seed flat in a covered area, and water every other day.

GERMINATION

- It can take ten days to one month for all viable seeds to sprout.
- Transplant them into 4-inch pots after four true leaves develop.
- Repot them when they become twice as tall as the pots, then repot them into larger pots and use new soil.

CUTTINGS

- Softwood cuttings are effective (same method as for *Ipomoea* and *Jacquemontia*).
- Take softwood cuttings in the morning hours from healthy plants.
- Remove all of the foliage and the weak green tips from the cuttings leaving 4–5-inch-long pieces and with at least three nodes.
- Keep them moist in a sealed plastic bag and out of the sun until you are ready to start them.
- Use a shallow flat with a mix made up of 3 parts perlite to 1 part vermiculite (3:1); no rooting powder treatments are needed.
- Insert at least one node under the moistened mix.
- Water the cuttings in; keep the flats in a covered, shaded area.
- *Bonamia* will produce roots within two months, pot them up and care for them using the same methods as described for the seedlings.

OUTPLANTING

- Outplant your *Bonamia* in three to six months, when the seedlings outgrow 4-inch pots; these are fast-growing plants.
- Choose a site where it can climb, for example, a tree, a fence, or a trellis; they can also be grown as a ground cover.
- Choose a site in partial shade, with well-draining soil; if the drainage is poor, amend the soil with cinder as recommended.
- Fertilize the plants every three to six months with 8-8-8 NPK fertilizer, or foliar feed them monthly.

PESTS

- Ants can be pests; look for them at the base of the plant where they farm harmful insects; they can be controlled using the recommended methods.

C

CONVOLVULACEAE
(MORNING GLORY FAMILY)

GENUS:
Cressa

COMMON NAME:
Alkaliweed

SPECIES	STATUS	HAWAIIAN RANGE
C. truxillensi		ind (O, Mo, Ka) dry sandy, mudflats

Full Sun

Range
Indigenous

Description
low-growing perennial herb

Propagation
seeds and cuttings



***C. truxillensis* flowers —F&KS**

GENERAL DESCRIPTION

Cressa is a clumpy, low-growing perennial herb usually with erect stems up to about 1 foot tall. Commonly known as spreading alkaliweed, it is native to the Western United States, Central and South America, along with Hawai'i. It grows in habitats with saline or alkaline soils, such as beaches, deserts & mudflats and is extremely tolerant of salt spray.

This perennial herb produces densely clumping branches that are lined with silky hairs and studded with many small hairy oval leaves. Beautiful, delicate white flowers grow at the tips of the branches, as do the browning seed capsules. These plants are similar to *Sesuvium* in habitat and are easily propagated. They would do well planted as a spreading groundcover in a sandy, coastal location. A good choice for a coastal restoration project planted along with sea purslane, dwarf naupaka and *Ipomoea* to name a few.

Range/habitat: Indigenous, subshrub or suffretescent herbs; stems erect or decumbent, usually 5-35cm long, hirsute to sericeous, occurring on drying mudflats and sand along and behind beaches.

Habit: Perennial herb woody at the base, subshrub.

Mature height: Less than 1 foot, 1 foot spread.



Cressa truxillensis —F&KS

Leaves: Leaves often fleshy, elliptic to lanceolate or ovate-lanceolate, hirsute to sericeous, margins entire, apex usually acute, petioles 0.5-2mm long.

Flowers/inflorescence: Flowers solitary and axillary, usually at the tips of the branches, pedicels 1-3mm long; sepals herbaceous, elliptic, inner ones sometimes obovate, pubescent, margins scarious, apex obtuse or acute; corolla white, lobes obtuse to subacute, with tufts of hairs near apex; stamens equal; filaments glandular pubescent at base; ovary ovoid, apex pubescent' styles unequal.

Fruit/seeds: Capsules tan to brown, apically pubescent, seed usually 1, dark brown or black, ovoid, glabrous (Wagner et al 1990).

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are dry and tan.
- Handle and clean them as directed cleaning for small dry seeds.
- No pretreatments are necessary for the brownish seed inside.
- Surface sow the small seeds on a seed mix made up of 3 parts perlite to 1 part potting mix or 1 part vermiculite (3:1) in a shallow flat and water them in.
- Keep your seed mix on the dry side, in a covered, protected area. Water every third day.

GERMINATION

- Germination may take two weeks to three months for all of the viable seeds to sprout.
- Transplant them into 2-inch pots after four to six true leaves have appeared, in a few more months.
- Use a sandy, well-draining mix.

CUTTINGS

- To take cuttings, use herbaceous stems about 3-5 inches in length, insert into a mixture of 3 parts perlite to 1 part vermiculite (3:1). Water in cuttings, then every three days or when dry.
- Rooting will take place in one to two months. Wait until the cuttings are well rooted, then transplant them into shallow pots with a well-draining sandy soil.

OUTPLANTING

- They will be ready for outplanting in about six months, when they have outgrown a 4-inch pot.
- Outplant them into an area with full sun, rocky & sandy well-draining soil; for proper drainage amend the site with black cinder & sand.
- Water your plants in, and then water them only in times of prolonged drought, if needed.

PEST

- In a landscape, slugs love to feed on these succulent, herbaceous plants; they can be controlled by applying the recommended slug bait.
- Ants can be pests; look for them at the base of the plant where they farm harmful insects such as mealybugs. They can be controlled using the recommended methods.

C

CONVOLVULACEAE

(MORNING GLORY FAMILY)

GENUS:

Ipomoea

HAWAIIAN NAME:

Hunakai

SPECIES	STATUS	HAWAIIAN RANGE
I. imperati	—	ind (Ni, K, O, Mo, M)

HAWAIIAN NAME:

Koali'awa

SPECIES	STATUS	HAWAIIAN RANGE
I. indica	—	ind (KI, HI)

HAWAIIAN NAME:

Pōhuehue; puhuehue

COMMON NAME:

Beach morning glory

SPECIES	STATUS	HAWAIIAN RANGE
Ipomoea pes-caprae ssp. *brasiliensis*	—	ind (KI, Le?, HI)

COMMON NAME:

Hawaiian moon flower

SPECIES	STATUS	HAWAIIAN RANGE
I. tuboides	—	end (HI)

Full Sun

Range
Hawaiian Endemic and Indigenous

Description
vine

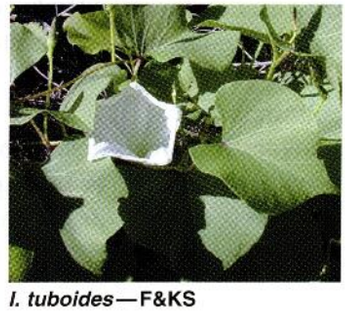
Propagation
seeds and cuttings



***Impomea indica* and Laysan Albatrosses – Midway Atoll—F&KS**



***Impomea imperati* – Maui—F&KS**



***I. tuboides*—F&KS**

GENERAL DESCRIPTION

There are many *Ipomoea* species found in the Hawaiian Islands, *I. tuboides* is the only endemic one. It is closely related to the Central and South American *I. squamosa*. This perennial vine grows on arid rocky slopes, with white individual flowers that bloom at night fading to lavender during the day. One to four seeds form in a brown capsule, the seeds have small hairs which help them float and disperse in the ocean currents to their next location.

Entire Range: Pantropical, in Hawai'i, on all the main islands.

Wild Habitat: Occurs on arid, rocky talus slopes or 'a'ā lava from sea level to 610 m elevation on all of the main Hawaiian Islands

Habit: Perennial vine.

Mature Height: Up to 5 m long

Stem/Trunk: Stem green or brownish-red with small green protuberances, prostrate or twining, slender and woody near the base, and glabrous mature stems

Leaves: The papery leaves occur at the end of petioles (stalks) 5–10 cm long; the leaf margins can be entire, toothed, or lobed, the apex is obtuse (blunt, from a wide angle) and

mucronulate (tipped with a sharp point); the base of the leaves are cordate (heart-shaped); leaves are 10–15 cm in length and diameter

Inflorescence/Flower: Solitary flowers occur in peduncles, which are longer than the leaves, flower stalks are 50–80 mm long; the white nocturnal flower corolla tube, salverform (trumpet-shaped), becomes lavender when it wilts; flowers are in multiples of five

Fruit: Capsules that are brown, glabrous, ovoid (egg-shaped) and 1–2 cm long

Seed: There are one to four dark brown seeds, ovoid, trigonous (three-angled), pubescent with short, erect hairs (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the seeds when the capsules are dry and brown; keep them dry in a paper bag.
- Separate the seeds from the capsules as directed for medium dry seeds.
- Soak the seeds in tap water for twenty-four hours; the seeds will float.
- Keep them in a covered, protected area.

GERMINATION

- Expect all of the seeds to germinate in three days to two months. If you want the seeds to germinate faster, scarify each seed as recommended.
- Transplant these fast-growing vines into 4-inch pots filled with well-draining mix.
- Amend the mix with cinder or perlite for good drainage.
- Keep the seedlings in the shade for two weeks; then move them into full sun to help harden them off.

CUTTINGS

- Take softwood cuttings in the morning hours from healthy plants.
- Remove all the foliage and the weak green tips of the cuttings, leaving 4–5 inch long pieces with at least three nodes on each.
- Keep them moist in a sealed plastic bag until it is time to start them.
- Use a shallow flat with mix made up of 3 parts perlite to 1 part vermiculite (3:1); no rooting powders are needed, and insert at least one node under the moistened mix.
- Water the cuttings in; keep the flats in a covered, shaded area.
- The cuttings will root in about two months; pot and care for them the same as for seedlings.

OUTPLANTING (fast-growing)

- *Ipomoea* will be ready for outplanting when they have outgrown a 4-inch pot, in about three months' time.
- Choose a site in full sun with rocky well-draining soil; for proper drainage amend the site with black cinder.
- Give the vine room to spread.
- Water them for two weeks, then in times of prolonged drought.
- Fertilize them with small amounts of 8-8-8 NPK fertilizer every six months or when the leaves turn yellow.

PESTS

- One pest of *Ipomoea* is the sweet potato weevil, which is ¼ inch long and resembles a large ant. Its snout, head, and wing covers are dark blue; its legs and prothorax are reddish-orange. The adult eats the leaves and lays its eggs into the stem near the ground. The eggs hatch in a week and feed while tunneling through the stem, causing it to wilt. The sweet potato weevil can be managed by applying a systemic pesticide (soil drench).
- Another pest to *Ipomoea* are red spider mites, which occur on the underside of the leaves and cause them to turn yellow. Spray with horticultural oil.

C

CONVOLVULACEAE

(MORNING GLORY FAMILY)

GENUS:

Jacquemontia

SPECIES	STATUS	HAWAIIAN RANGE
J. sandwicensis	—	end (KL, Le, HI)

HAWAIIAN NAMES:

Pā'ū o hi'iaka; kākua o hi'iaka

Full Sun

Range
Endemic

Description
vine or ground cover

Propagation
seeds and cuttings

1: Range differs for each species.



J. sandwicensis **flowers – O'ahu—CC**

GENERAL DESCRIPTION

Jacquemontia is a beautiful and easy plant to grow and maintain in a landscape. This sprawling vine is found in coastal areas throughout the islands. Often roots at the nodes to help hold the plant in place during strong coastal winds, with thick small, rounded leaves. *J. sandwicensis* from the drier southwest side of the Big island, their leaves are densely tomentose (white woolly hairs), giving the whole plant a silver appearance, which is very attractive, especially when planted with a black cinder background. The small pale blue flowers bloom from December through July, small dry tan seed capsules contain one to four roundish seeds. The leaves and stems of this plant were used by Hawaiians to treat babies with thrush ('ea) and as a laxative (Wagner et al. 1990). It is a very attractive ground cover in drier gardens and stabilizes the soil by rooting at the nodes. It adds a great contrast when planted among low-growing 'ilima papa (*Sida fallax*), which does not root at the nodes.

Entire Range: *J. sandwicensis* is a Hawaiian endemic

Wild Habitat: Coastal strand habitats made up of various substrates

Habit: Herbaceous prostrate vine
Mature Height: 3 m long
Stem/Trunk: Stems are subglabrous to densely tomentose (hairy) with overlapping, two-branched hairs
Leaves: Leaves thick or fleshy, elliptic, 5 cm by 3 cm, entire margins
Inflorescence/Flower: Flowers in axillary cymes, with 5–10 mm pedicels (stalks), corolla pale blue or white, broadly campanulate (bell-shaped) 7–15 mm long
Fruit: Tan to brown capsules, quadrangular-globose, 4–6 mm in diameter, and enclosed by enlarged sepals
Seed: Seeds are one to four, trigonous (three-angled), 2–3 mm long, with or without winged margins; the seed coat is minutely areolate (marked by a different texture) and the seeds are sometimes faintly ruminate (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the small capsules along the stem when they are dry and brownish-tan in color.
- Keep them dry in a paper bag until they can be cleaned.
- Separate the small brown seeds from the capsules as recommended for small dry seeds.
- No pretreatments are necessary; surface sow the seeds onto a dry mix with 3 parts perlite to 1 part potting mix (3:1) in a shallow pot or flat; water them in.
- Keep them in a protected, covered area.

GERMINATION

- Germination of all viable seeds may take one week to two months.
- Transplant them into 2-inch pots with a well-draining soil.
- Keep them in a shaded, protected area for two weeks; then move them into a site with full sun to harden them off.

CUTTINGS

- Take softwood cuttings in the morning hours from healthy plants.
- Remove all the foliage and the weak green tips of the cuttings, leaving 4–5 inch long pieces, each having at least three nodes.
- Keep them moist in a sealed plastic bag until you can pot them, no longer then a day or so.
- Use a shallow flat with a moistened mix of 3 parts perlite to 1 part vermiculite (3:1) and insert at least one node under the mix; no rooting powders are needed.
- Water the cuttings in; keep the flats in a covered, shaded area until rooted.
- Rooting in about two to three months; pot and care for them the same as for seedlings.

OUTPLANTING (fast-growing)

- *Jacquemontia* will be ready for outplanting when they have outgrown a 4-inch to 6-inch pot, in about three months time.
- Choose a site in full sun with well-draining cindery or sandy soil.
- Give the vine room to spread and grow; outplant with low growing 'ilima as they grow well together, both liking the same dry environment.
- Water them in for two weeks and fertilize them with small amounts of 8-8-8 NPK fertilizer if they are growing slow and need a boost.

PESTS

- Ants can be pests; look for them at the base of the plant where they farm harmful insects such as mealybugs. They can be controlled using the recommended methods.
- Slugs can also be a nuisance; control them with the recommended slug bait.

C

CUCURBITACEAE

(GOURD FAMILY)

GENUS:

Sicyos

HAWAIIAN NAMES:

ʻĀnunu; puaokama; kūpala; panunukuahiwi

Fourteen endemic species found on all of the main islands

SPECIES	RANGE
S. alba	(H)
S. anunu	(L, H)
S. cucumerinus	(Mo, M, H)
S. erostratus	(O, Mo)
S. herbstii	(K, Mo)
S. hillebrandii	(M)
S. hispidus	(Mo, L, M, H)
S. lanceoloideus (*syn: S.* sp. *"A"*)	(K, O)
S. lasiocephalus	(Mo, H)
S. macrophyllus	(M, H)
S. maximowiczii	(Le, Ni, O)
S. pachycarpus	(HI)
S. semitonsus	(NWHI)
S. waimanaloensis	(K, O, Mo)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
climbing herb

Propagation
seeds



***Sicyos alba* flower buds – Hawai'i—SP**

GENERAL DESCRIPTION

ʻĀnunu is a thin, sprawling, sometimes short-lived perennial or annual herb that occurs in dry coastal communities to subalpine forests. It grows up or over other plants, holding on with branching tendrils. An abundance of dry fruits develop and these small fruits are very easily dispersed around the islands, because of the tiny curled hairs that adhere to passers-by.

Entire Range: Hawaiian endemic

Wild Habitat: Wet forests, windswept slopes, leeward slopes, talus slopes, northern forests, dry forests, subalpine forests, shrub communities, and shrub coastal communities

Habit: Climbing or trailing annual or perennial herb

Mature Height: 10–20 m long

Stem/Trunk: Stems puberulent (covered with fine, short hairs), hirsute to glabrous, some with glands

Leaves: Thin leaves are lobed, or heart-shaped, with angled stems

Inflorescence/Flower: Small flowers monoecious (female and male flowers on the same plant), pistillate flowers in pedunculate (borne on a stalk) heads; perianth (sepals and petals) smaller in male flowers, corolla (all of the petals) five lobed and whitish-green, axillary (arising from a leaf axil)

Fruit: Indehiscent fruit, variable in each species

Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the small fruits when they are brownish and dry; keep them dry in a paper bag.
- Clean them as recommended for small dry seeds.
- The seeds can be stored up to seven years in desiccation chambers, or refrigerated dry.
- Soak the seeds for twenty-four to forty-eight hours in tap water, and then air-dry the seeds.
- Surface sow the seeds on a dry mix of 3 parts perlite to 1 part potting mix (3:1), then water the seeds in.
- Keep them covered in a protected area.



***Sicyos* sp. – Maui—F&KS**

GERMINATION

- It will take between one month and one year for all the viable seeds to sprout.
- The seedlings are tiny. Wait until they have at least four to six true leaves before transplanting; this can take a couple of months. Foliar feed them if the seedlings are yellowish.
- Transplant them into 2-inch pots of well-draining soil.
- Keep the seedlings in a protected, shaded area; they are initially sensitive plants.
- Repot the seedlings into larger pots and add new soil every five to six months.
- These short-lived plants do well in pots; to prolong their lives, trim off the flowers.



***Sicyos waimanaloensis* seedlings – NTBG nursery—PT**

OUTPLANTING

- To outplant, wait until the plant has outgrown a 6-inch pot, and before the plant blooms.
- Outplant the ʻānu-nu near other plants to climb on or over; it is an attractive plant as it trails over black lava rocks.
- Place them in partial to full sun in a well-draining soil amended with cinder.
- ʻĀnunu may become weedy in the garden because the seeds germinate freely.
- Fertilize before blooming with 8-8-8 NPK fertilizer or foliar feed monthly.

PESTS

- Slugs are harmful pests because they eat the young seedlings and older plants; they can be controlled with slug-bait.
- Use a systemic pesticide in the soil for sucking pests that attack the foliage or stems.

CUSCUTACEAE

(DODDER FAMILY)

GENUS:

Cuscuta

SPECIES	STATUS	HAWAIIAN RANGE
C. sandwichiana	—	end (HI exc. Ka)

HAWAIIAN NAMES:

Kauna'oa; kauna'oa kahakai; kauna'oa lei; kauno'a; pōlolo

Full Sun

Range
Hawaiian Endemic

Description
vine

Propagation
seeds



***Cuscuta sandwichiana* flowers – Gemma and Koske**

GENERAL DESCRIPTION

The native dodder is a curious parasitic plant with its slender, tangled, twisted, orange-yellow stems that grow up and over ground covers, shrubs, or trees. It is not particular as to what host it chooses, attaching to whatever plant is closest. The stems have tiny scale-like leaves and haustoria, which are, specialized roots of parasitic vascular plants capable of penetrating into the host plant's tissues to absorb its nutrients. The tiny yellowish flowers cluster at the leaf scale axils, as do the tiny grouped capsules that contain dark reddish-brown seeds. The tiny seeds germinate and root in the soil first, and then the plant takes on its parasitic lifestyle, sometimes killing the host plant. Hawaiians have used it in making attractive leis, it is the official lei to the island of Lāna'i (Ka Lei et al. 1989)

Entire Range: Hawaiian endemic

Wild Habitat: A non-discriminating parasite using an array of native and naturalized coastal plants as hosts. *Cuscuta* prefers coastal habitat areas, often found in sandy soil; sea level to 300 m on all main Hawaiian Islands except Kaho'olawe

Habit: A parasitic annual or perennial twining vine, attaching to the host by haustoria, appearing leafless and rootless. The chlorophyll is absent or scanty; the stems are yellow to dark orange to yellowish-green, and usually filiform. The juvenile plants have a small

root system that rapidly degenerates. At maturity the plants are not connected to the ground. They are pubescent with simple hairs. A "tangled, twist of hair" is the Arabic meaning for *kuskut*

Mature Height: Not applicable

Stem/Trunk: Slender stems, yellow to yellowish-orange

Leaves: Leaves very reduced and scale-like

Inflorescence/Flower: Small perfect (both functional male and female structures), actinomorphic (radially symmetrical) flowers (3–4 mm long) yellowish, in compact, short stalked, cymose clusters; often with glands and pubescent (hairy); spreading erect, calyx lobes triangular-ovate, nearly enclosing the corolla, scales below stamens absent or reduced and triangular or forked

Fruit: Capsules are globose to depressed globose, about 3–3.5 mm in diameter, and the withered corolla surrounding the capsule

Seed: Seeds dark reddish-brown, depressed globose, about 2 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are ripe, and keep them dry in a paper bag until they are ready to be sown.
- Rub the capsules in a strainer, which dislodges the tiny dark seeds.
- Start the seeds fresh by surface sowing them on a mix of 3 parts perlite to 1 part vermiculite (3:1) and water them in.
- Keep them in a covered area, watering them when they are dry.

GERMINATION

- Germination may take from one to four months for all the viable seeds to sprout.
- When ready, transplant them into 4-inch pots with a host plant, such as *Dodonaea viscosa*, or *Scaevola sericea*.
- Use a well-draining sandy or cindery soil.
- Repot the seedlings when the plants grow twice as tall as the pots.
- Foliar feed them monthly to keep the host plant healthy.



Cuscuta sandwichiana **– Maui — F&KS**

OUTPLANTING

- It is time to outplant in six months to one year, when both plants are healthy and growing vigorously.
- Choose a site with full sun that has a well-draining soil amended with sand or cinder.
- The host plant may eventually die. If this happens, replace it with another healthy host plant.

PESTS

- Ants can farm insects on the plant. To control them, use the ant bait protocol and spray horticultural oil or use systemic pesticides for the insects.

C

CYPERACEAE

(SEDGE FAMILY)

Sun Requirements
Species specific

Range
Endemic or Indigenous

Description
rush-like or grass-like

Propagation
seeds and cuttings

GENERA: ***Bolboschoenus*** COMMON NAME: **Bulrush** HAWAIIAN NAME: **Kaluha**

SPECIES	STATUS	HAWAIIAN RANGE
B. maritimus	–	ind (Ni, K, O, Mo, M, H)

GENERA: ***Carex***

SPECIES	STATUS	HAWAIIAN RANGE
Seven endemic and three indigenous		(HI)

GENERA: ***Cladium*** COMMON NAME: **Saw-grass**

HAWAIIAN NAME: **'Uki**

SPECIES	STATUS	HAWAIIAN RANGE
C. Jamaicense	–	ind (K, O, Mo, M, H)

GENERA: ***Cyperus*** COMMON NAME: **Umbrella sedge**

HAWAIIAN NAMES: **Makaloa, makoloa, ehu'awa, pu'uka'a**

SPECIES	STATUS	HAWAIIAN RANGE
Thirteen endemic and five indigenous		(Le, HI)

GENERA: ***Eleocharis*** COMMON NAME: **Spikerush**

HAWAIIAN NAMES: **Kohekohe, pipiwai**

SPECIES	STATUS	HAWAIIAN RANGE
E. obtusa	–	ind (K, O, Mo, M, H)

GENERA: ***Fimbristylis*** HAWAIIAN NAMES: **Mau'u'aki'aki (Ni'ihau)**

SPECIES	STATUS	HAWAIIAN RANGE
F. cymosa ssp. *spathacea*	–	ind (Ni, K, O, M, H)
F. cymosa ssp. *umbellato-capitata*	–	ind (Le, HI exc. Ka)
F. dichotoma	–	ind (K, O, Mo, L, M, H)
F. hawaiiensis	–	end (H)

GENERA: ***Gahnia***

SPECIES	STATUS	HAWAIIAN RANGE
G. aspera ssp. *globosa*	–	end (K, O)
G. beecheyi	–	end (K, O, Mo, L, M, H)
G. vitiensis ssp. *kauaiensis*	–	end (K)

GENERA: ***Machaerina*** HAWAIIAN NAMES: **'Uki; 'ahaniu**

SPECIES	STATUS	HAWAIIAN RANGE
M. angustifolia	–	ind (K, O, Mo, L, M, H)
M. mariscoides ssp. *meyenii*	–	end (K, O, Mo, L, M, H)

GENERA: ***Morelotia***

SPECIES	STATUS	HAWAIIAN RANGE
M. gahniiformis	–	end (K Mo L M H)

GENERA: ***Oreobolus***

SPECIES	STATUS	HAWAIIAN RANGE
O. furcatus	–	end (K, O, Mo, M)

GENERA: ***Pycreus***
(Merged with *Cyperus* (Wagner & Herbst 1999))

GENERA: ***Rhynchospora*** COMMON NAME: **Beak-rush** HAWAIIAN NAME: **Pu'uko'a**

SPECIES	STATUS	HAWAIIAN RANGE
R. chinensis ssp. *spiciformis*	–	ind (K, O, Mo, M, H)
R. rugosa ssp. *lavarum*	–	ind (K, O, Mo, M, H)
R. sclerioides	–	ind (K, O, Mo, L, M, H)

GENERA: ***Schoenoplectus*** (syn: *Schoenoplectiella*)

HAWAIIAN NAMES: **Kaluha; 'aka'akai; 'aka'akai naku; naku; nanaku; neki**

SPECIES	STATUS	HAWAIIAN RANGE
S. juncoides	–	ind (K, H)
S. tabernaemontani	–	ind (Ni, K, O, Mo, H)

GENERA: ***Scleria*** COMMON NAME: **Nutgrass**

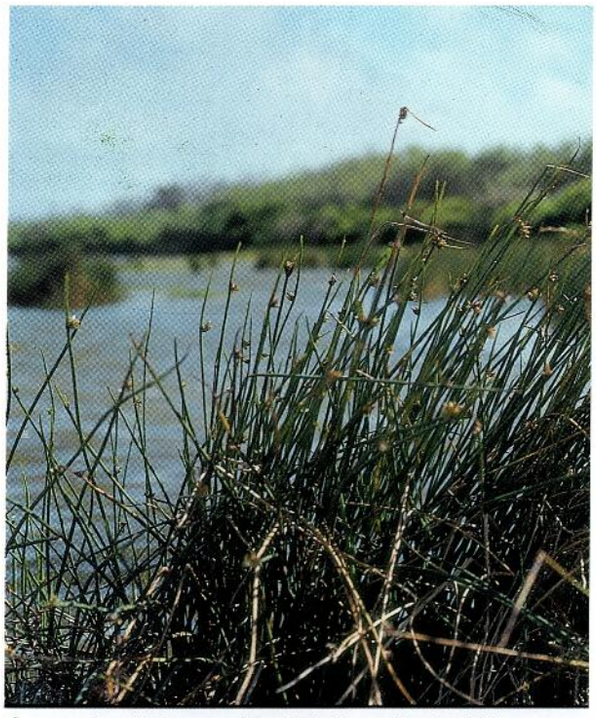
SPECIES	STATUS	HAWAIIAN RANGE
S. testacea	–	ind. (Mo, M, H)

GENERA: ***Torulinium***
(Merged with *Cyperus* (Wagner & Herbst 1999))

HAWAIIAN NAMES: **Pu'uka'a, kili'o'opu, kiolohia, mau'u pu'uka'a**

GENERA: ***Uncinia***

SPECIES	STATUS	HAWAIIAN RANGE
U. brevicaulis	–	ind (M)
U. uncinata	–	ind (K, Mo, M, H)



Cyperus laevigatus seeds – Makaloa – Maui—DR



Mariscus sandwicensis seed heads – Kaua'i—KRW

GENERAL DESCRIPTION

The genera represented here from within the sedge family are all perennials or annuals with rush-like or grass-like appearance, and with rhizomes or stolons for roots. The fruits are dry achenes, many with thick endocarps (embryo coverings). Birds easily disperse the seeds throughout the islands. An easy way to distinguish sedges from rushes is to remember that generally (regarding their stems in cross-section), "sedges have edges and rushes are round."

Entire Range: Taxa described here are either endemic or indigenous to Hawai'i

Wild Habitat: Occurs in all the various Hawaiian habitats from wet bogs to dry deserts

Habit: Perennials or annuals with rush-like or grass-like habits

Mature Height: Variable

Stem/Trunk: Sedges may have rhizomes or stolons, culms (aerial stems) that are scape-like or leafy, and the stems are usually trigonous (with three angles) and solid

Leaves: The leaves are long narrow or wide at the base and tapering at the top

Inflorescence/Flower: The flowers develop on long spikes that branch out into spikelets

Fruit: The fruit is an achene or a fruit with a thick, bony endocarp

Seed: Small dry seeds (Wagner et al. 1990)



Machaerina angustifolia –Maui—KRW

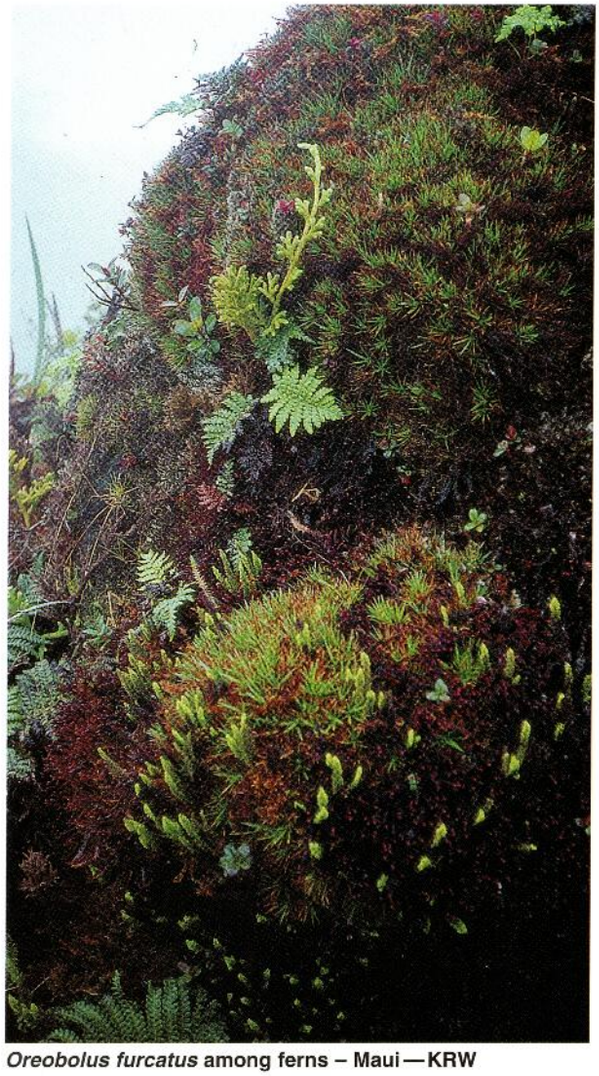
PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the dry achene (seeds) when they turn brown and are easily removed from the spikes, or cut them off from the spikes; keep the seeds in a dry paper bag.
- Separate the seeds from the spikelets and remove the seed coating as directed for small dry seeds. If you cannot distinguish the seeds from the litter, surface sow the litter also. Or blow on the litter and seeds in a bowl. The light litter will cast off and blow away, leaving the heavier seeds behind.



Gahnia beechyi—KRW



Oreobolus furcatus among ferns – Maui—KRW



Fimbristylis hawaiiensis—SP



Cyperus trachysanthos seed heads—F&KS



Oreobolus furatus—F&KS

- The seeds can be stored in desiccation for up to eight years.
- No pretreatments are needed; surface sow the seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1) then water the seeds in.
- Keep the flats in a covered area, watering every other day.

GERMINATION

- Germination may occur in two weeks to three months for all viable seeds to sprout.
- Then transplant the seedlings into 2–4-inch pots depending on the size of the root ball.
- Use a well-draining mix amended with cinder.
- For those sedges from wetter habitats add more peat moss than cinder.
- Keep seedlings in a protected area for about a month, then move them gradually into more sun.

CUTTINGS (rhizomes and stolons)

- Dig up under the sedge clumps to expose the underground stems. Then cut off the sections or clumps.
- Cut the leaves in half; keep them moist in a sealed plastic bag until it is time to pot them up.
- Pot the clumps or 3-inch pieces of rhizomes into 4-inch pots of 3 parts perlite to 1 part potting mix (3:1); no fertilizer is needed; treat them as cuttings.
- In one to two months, your sedge will show new foliage growth. When it does, give it a small amount of 8-8-8 NPK fertilizer or use a foliar fertilizer.
- Repot into 6-inch to 1-gallon pots in three to six months, depending on the amount of plant growth.
- Move them into more sun to harden them off for outplanting.

OUTPLANTING

- Choose a site favorable to its native habitat; from dry deserts to wet bogs.
- Amend with the cinder to improve the soil and reduce poor drainage.
- Water the plants in at first, then water only in times of prolonged drought.
- These plants are easy to grow and maintain in the landscape.
- Trim off the flower spikes if you want the plant to last years longer.
- The sedge will become weedy in the landscape; seeds that fall to the ground germinate readily. Seedlings can be moved to other locations or potted up and given away.

PESTS

- Ants live at the base of the clumps and farm mealybugs, scales and aphids; use ant bait as recommended.
- Thrips can also be a pest, and they can cause the leaves to silver. Use a systemic pesticide as recommended.

D

DROSERACEAE

(SUNDEW FAMILY)

GENUS:
Drosera

COMMON NAMES:
Sundew

HAWAIIAN NAME:
Mikinalo

SPECIES	STATUS	HAWAIIAN RANGE
D. anglica	—	ind (K)

Partial Sun

Range
Indigenous

Description
small herb

Propagation
seeds



Drosera anglica **flowers and seeds capsules – Kaua'i—DB**

GENERAL DESCRIPTION

The tiny seeds of the sundew (*D. anglica*) get around with the help of birds. They may have arrived to the Hawaiian Islands embedded in the mud on the feet of shorebirds such as the lesser golden plover (*Pluvialis dominica*). Sundew's have oblong leaves with a clear, gluey, sweet nectar on tentacles that attracts and traps insects for food and nutrients. This is necessary because of the low nitrogen content of the soil in bogs. These plants do not go dormant like many sundews; you can get year-round enjoyment watching these tiny plants catching gnats on their specialized leaves. Do not collect these very delicate, sensitive plants, unless

for conservation purposes. Having the proper permits and a cool, high elevation environment to grow them in.

Entire Range: Indigenous to Hawai'i and found throughout the colder regions of the northern hemisphere

Wild Habitat: Bogs

Habit: A small, acaulescent (without a stem) insectivorous perennial (rarely annual) herb

Mature Height: 10–20 cm

Stem/Trunk: Short rhizomes, otherwise acaulescent

Leaves: The leaves are basal, a rosette, and the modified leaf blade is covered with long, glandular, tentacle hairs with swollen reddish heads that secrete a sticky, glistening fluid. Insects such as flies are attracted to the plant and get stuck once they come in contact with it

Inflorescence/Flower: The small, perfect, actinomorphic white flowers grow on top of long spikes, cymes opening for a short time. The ovary is superior, three carpellate, with ovules three to numerous

Fruit: Loculicidal capsules

Seed: The seeds are small and dark brown, irregular fusiform about 1.2 mm long, and the surface longitudinally striate (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules containing small brown seeds from on top of the spikes arising above the plants. Keep the capsules dry until cleaning.
- Separate the seeds from the capsules as directed for small dry seeds.
- Seeds can be stored in a refrigerator; they lose their viability stored at room temperature.
- Surface sow the tiny seeds on moistened sphagnum moss in a shallow container that has holes in the sides halfway up, not on the bottom. Keep the moss moist at all times.
- Or place a container with holes in the bottom in a shallow dish of water, distilled or rainwater works best.
- In hot, dry locations, keep the container in a mist system or in a sealed plastic bag to create more humidity.
- Place containers in a bright location but not in direct sunlight.

GERMINATION

- Seeds will sprout in four to eight weeks. At that time, remove any plastic bag or covering.
- When the plants are of a manageable size, carefully pluck out the small sundews from the moss, trying not to break any roots, and plant them into their own 2-inch pots.
- Place them in a mix of half peat to half rinsed sand or moist sphagnum moss (1:1), and do not let them dry out.
- Foliar feed them monthly with diluted Miracid® or epiphytic fertilizer. Fertilizer is not necessary if your plant is catching plenty of insects.
- Keep sundews out of doors in partial shade so the insects can get to them for food.

CUTTINGS (division)

- Small plants are easily dug up with soil and potted into their own pots.
- I do not recommend going out into the wild and digging up these delicate plants unless you have the proper collecting permits.

PESTS

- Slugs will eat the entire plant in a single night. Look for trails of slime across the moss, and apply slug bait as directed.

E

EBENACEAE
(EBONY FAMILY)

GENUS:
Diospyros

COMMON NAMES:
Hawaiian ebony; persimmon

HAWAIIAN NAME:
Lama; ēlama

SPECIES	STATUS	HAWAIIAN RANGE
D. hillebrandii	—	end (K, O)
D. sandwicensis	—	end (HI exc. Ni, Ka)



***Diospyros hillebrandii* new foliage — JO**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds

GENERAL DESCRIPTION

Lama is a hardy, slow growing but easy tree to maintain in drier landscapes. In the Hawaiian language, *lama* means light, and the Hawaiians used the wood for building temples and offerings to the hula goddess Laka, because the name suggest enlightenment (Pukui, Elbert, Mookini 1992)

I set up an experiment with lama seeds (the fruit had dried on the seeds and they had to be soaked first to remove the pulp) using three types of pretreatments, and a control (one with no pretreatments).

Pretreatments:
- Tap-water soak for forty-four hours
- Hand-hot water soak forty-four hours
- Scarification
- No pretreatments (control)

Results:
- The hot-water-soaked and scarified seeds started to germinate in thirty-six days.
- The tap-water-soaked seeds started to germinate in thirty-nine days.
- All the scarified seeds sprouted in fifty-four days.
- No pretreatments were conducted, only the pulp was removed. They germinated in thirty-five days.

This indicates that for the best results, seeds should be collected when they are mature. Do not let the pulp dry on the seeds. Pretreated or not, they will still germinate within about a month. Soaked seeds, both hot water and tap water, took sixty-eight days for all seeds to sprout.

Entire Range: Hawaiian endemic
Wild Habitat: Lowland dry forests to mesic-dry forests
Habit: Small tree
Mature Height: 20–35 ft (6–11 m)
Stem/Trunk: Branching hardwood
Leaves: The leaves are thick, leathery, dark or pale green, surfaces pitted or smooth, and the leaves alternate. They are oblong-elliptic (*D. hillebrandii*) or lanceolate (*D. sandwicensis*). The new leaf growth is reddish.
Inflorescence/Flower: The small, unisexual, actinomorphic, and solitary greenish-white flowers are borne close to the twigs
Fruit: The fruits are small, orange to red and pulpy, and are edible
Seed: There are one to four seeds per fruit, about 0.5 inch (1.5 cm) long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect mature fruit when they are orange-red in color. Keep them moist in a plastic bag.
- Remove the pulp by hand or as instructed for pulpy large fruits.
- Do not store the seeds because they will lose their viability. Start the seeds as soon as possible.


***Diospros hillebrandii* fruits — JO**

- They will start to sprout in a month or so, with or without soaking and scarifying. What is important is that the seeds are mature, the pulp is removed, and the seeds are sown soon after collecting.
- All the seeds will sprout in about two months if each seed is scarified (nicked); this can be time consuming if there are many seeds.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1) then cover with ½ inch more of the mix and water them in.
- Keep them in a covered area that is protected from rats, who find these seeds appetizing.

GERMINATION

- It may take one to three months for all viable seeds to sprout.
- Transplant the tree seedlings soon after they sprout (about two weeks to one month), and handle them carefully by their leaves.
- These seedlings have stiff black roots and pinkish stems. Pot them into 4-inch pots.
- Use a well-draining mix; amend it with black cinder or No. 3 perlite.
- Fertilize the plants with 8-8-8 NPK fertilizer or foliar feed them every three to six months.
- Repot them into larger, deeper tree pots and add new soil about every six months, depending on their growth rate.

OUTPLANTING

- *Diospyros* will be ready for planting out within one to two years. You can tell when it is ready because the lama will have outgrown a 1–2-gallon pot.
- Choose a site with full to partial sun and well-draining soil and amend as recommended.
- Water the plants in initially, and then water them in times of prolonged drought.
- If there are strong winds in the planting site area, give the new young trees support until they become established and are growing strong, as indicated by new growth.
- Plant the lama tree with other native shrubs, grasses, and ground covers that also prefer dry locations.

PESTS

- The Chinese rose beetle can eat holes in some of the leaves. Although it will not kill the plant, the results can be unsightly. They can be controlled with systemic pesticides, using as recommended.
- Ants can live at the base of the plants and farm mealybugs, scales, and aphids; use ant bait as recommended.
- Spray horticultural oils to control the insects.

E

ELAEOCARPACEAE

(ELAEOCARPUS FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Elaeocarpus	**Kalia**	*E. bifidus*	—	end (K, O)



***Elaeocarpus bifidus* flowers — GDC**

Shady

Range
Hawaiian Endemic

Description
tree

Propagation
seeds

GENERAL DESCRIPTION

Kalia is commonly found in higher elevations on Kauai and Oahu, related to the *E. angustifolius* (Blue-marble tree). The green, olive-like fruit (drupe) blackens with maturity and has a hard seed coat. It can be recognized by the gall growth on the branches (called "witches broom"), which is caused by mite infestation. The Hawaiians used the inner bark for cordage and branches made into thatching rods for grass huts construction (Wagner et al. 1990). I have had trouble germinating these tough seeds with their stony endocarps (enclosing the

embryo). I received very small numbers of the seeds at one time, making it difficult to set up valid tests on their viability and germination rates.

Entire Range: Hawaiian endemic

Wild Habitat: Diverse mesic to wet forests and bog margins at about 3,000 ft elevation (914 m)

Habit: Branching tree

Mature Height: 7–40 ft (2.5–10 m)

Stem/Trunk: Branching; apex of the new growth, or young branches is viscid

Leaves: Alternate, papery, dark green, ovate to lanceolate (11–18 cm long and 3.5–7.5 cm wide), sparsely appressed pubescent (fine coat of hairs), to glabrous (without hairs), margins with shallow, rounded teeth, leaf base is asymmetrical, petioles (leaf stalks) green to pale orange and 3.5–6.5 cm long. The stipules are lanceolate, about 2 mm long and not persistent (fall off easily)

Inflorescence/Flower: Flowers in racemes, with greenish-white flowers grouped on long forked spikes from the leaf axils at the branch ends

Fruit: The fruits are drupaceous and dull green, ripening to black; ellipsoid, 2.5 cm long, with a stony endocarp; the receptacle is pubescent (covered with hairs). The name is derived from the Greek *elaia*, olive, and *karpos*, fruit, referring to the olive-like fruit of these plants

Seed: There is one seed per fruit without an aril; the endosperm has copious oils and proteins (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are mature and black and keep them moist in plastic bag.
- Remove the softened pulp as directed for large pulpy seeds, then air-dry them.
- I have no experience or information on their tolerance to seed storage.
- These seeds have stone hard endocarps that need to be penetrated in order to germinate. I recommend scarification, or soaking them in water for a couple of days.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1) then cover the seeds with 1 inch of the mix, and water the seeds in.
- Keep them in a cool, covered, shaded area.
- No information is available on germination rates or viability percentages. The seeds I worked with never germinated. Instead, in every case, the embryos rotted.

E

EPACRIDACEAE
(EPACRIS FAMILY)

GENUS:
Leptecophylla (syn: *Styphelia*)

HAWAIIAN NAMES:
Pūkiawe; maiele; ʻaʻaliʻi mahu

SPECIES	STATUS	HAWAIIAN RANGE
L. tameiameiae	—	ind (HI exc. Ni, Ka)

Full Sun – Partial Sun

Range
Indigenous

Description
spreading shrub

Propagation
seeds



L. tameiameiae **fruit /seeds — F&KS**

GENERAL DESCRIPTION

Species within the genus *Leptecophylla* range from Australia to Hawaiʻi. In Hawaiʻi it is a very common shrub, occurring from low elevations to the cool, dry alpine zone. The small narrow leaves are dull green above, pale silvery white underneath and sharply pointed. The fruits are small round red to white drupes. Hawaiians used the bright red or white fruit in leis, and the wood was used in the cremation of outlaws. Pūkiawe is a very attractive shrub when it is in bloom and fruiting at the same time. These are slow-growing seedlings, and it can take many years before the shrub is large and strong enough to be outplanted. The easiest way to cultivate them is to dig up 4–5-inch seedlings in washouts or before a road clearing for fire breaks. Collect some of the soil they are growing in, which may contain beneficial microorganisms, and add it to a well-draining, cindery mix. It is always important to obtain the proper collection permits before removing any plant from state or federal land.

Entire Range: Indigenous to Hawaiʻi and the Marquesas Islands

Wild Habitat: Mesic forest to open areas of low elevation or montane wet forests, fog-swept alpine shrubland, and bogs

Habit: Compact to slender, erect and spreading shrub, sometimes tree-like, occasionally

dwarfed in bogs. These plants are extremely variable both morphologically and ecologically

Mature Height: 3–6 ft (1–2 m)

Stem/Trunk: Stems about 1–3 m long

Leaves: Compact, leathery, lanceolate to elliptic (4–10 mm long by 1.5–5 mm wide), upper leaf surface dull or glossy, lower surface with conspicuous veins, glaucous

Inflorescence/Flower: Tiny white flowers, perfect or unisexual, developing at leaf axils

Fruit: Red to white drupe, with mealy fruit, bony endocarp, depressed globose, 4–6 mm wide

Seed: Small, pale brown, ovoid and about 0.2 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits (drupes) when they are soft and red or white in color; keep them moist in a plastic bag.
- Remove the pulp as directed for small pulpy seeds.
- Then soak the seeds in hand-hot water for twenty-four hours or tap water for forty-eight hours. Then air-dry the seeds.
- Surface sow the small, hard, brown seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1), and water the seeds in.
- Keep them in a covered, protected area, watering every other day or when it is dry.

GERMINATION (slow to germinate)

- Germination can take three to six months. The seeds are small, but drupes have hard seed coats. Foliar feed the germinated seedlings monthly.
- Transplant them into 2-inch pots, when the seedlings are 1 inch high, which may be another three or four months. After sprouting handle them only by their leaves.
- Amend them with the transplant mix using black cinder or No. 3 perlite as directed.
- Keep these slow-growing seedlings in a protected area in partial shade.
- Repot them into bigger pots about every six months to a year.
- Gradually move them into more sun to harden them off.

OUTPLANTING

- The seedlings can take years to grow big enough to be outplanted. Be patient.
- They are ready for outplanting when the plants are 4–5 inches tall, or when they have outgrown a 1-gallon pot. This can take up to a year or so.
- Choose a site in full to partial sun, with well-draining soil. Amend the soil as recommended.
- Water in the plant well, then water weekly depending on the rainfall, until you see new growth.
- Fertilize the plants every six to eight months for healthy, strong growth.

PESTS

- Red spider mites can occur on the undersides of leaves, causing the plant to look sickly. Wash off the mites or spray them with horticultural oil.
- Control ants from the base of the plant by applying ant bait.



Pūkiawe growth habit – Maui — F&KS

E

ERICACEAE

(HEATH FAMILY)

GENUS:

Vaccinium

HAWAIIAN NAMES:

ʻŌhelo; ʻōhelo kau lāʻau

COMMON NAME:

Blueberry

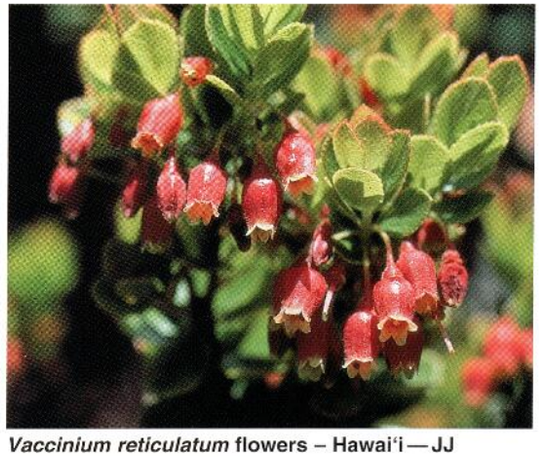
SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
V. calycinum	—	end (HI exc. Ni, Ka) wet forests or bogs
V. dentatum	—	end (HI exc. Ni, Ka) wet forests, bogs or swamps
V. reticulatum	R	end (K, O, Mo); common (M, H) lava flows, alpine areas

Partial Sun

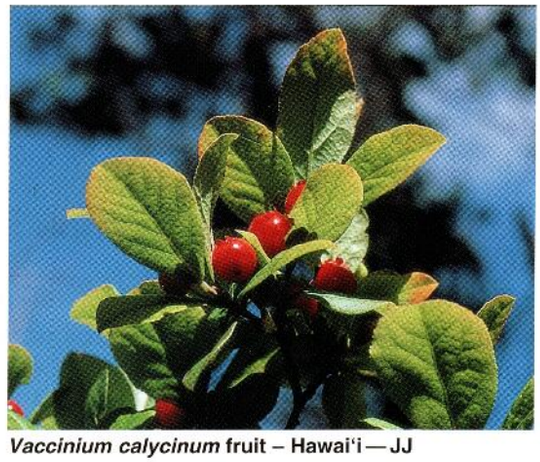
Range
Hawaiian Endemic

Description
shrub

Propagation
seeds and cuttings



Vaccinium reticulatum **flowers – Hawaiʻi — JJ**



Vaccinium calycinum **fruit – Hawaiʻi — JJ**

GENERAL DESCRIPTION

Most species of ʻōhelo grow in open places as erect to sprawling shrubs, with leathery, round-to-oblong alternate leaves 1–3 inches long, covered with a network of veins. The green fruit turns red to yellow when ripe and mature. Local residents make delicious jams from the fruit; the peak season is June to September.

I had good success with growing these species as cuttings. However, I did not have any success germinating seeds of this genus. I tried soaking the seeds for different lengths of time, and I also tried not soaking the seeds. I even had the flats under a mist system. Maybe trying to grow them at sea level was a factor in the poor results because in the wild, they grow at high elevations on the islands and on the mainland. I did observe at a mid-elevation nursery on the Big Island near volcano that Patty Moriyasu had no problem sprouting seeds. She had surface-sown them on small black cinder and put them under a mist system. She said high humidity was the key to germinating this genus. I took a flat of seedlings home to 300 ft elevation, even though the flat was in a nursery setting without a mist system. They all slowly died in two months for reasons unknown.

The ʻōhelo is a blueberry relative from temperate zones on the mainland, where they are grown from hardwood and softwood cuttings within a mist system. Birds probably brought ʻōhelo to the islands in their digestive tracts.

Entire Range: Hawaiian endemic

Wild Habitat: Terrestrial and sometimes epiphytic; occurring in wet forests and bogs, in open areas, on stumps in wet forests, along windy exposed ridges, disturbed areas, alpine and subalpine shrublands

Habit: Highly variable morphologically: erect shrubs, to decumbent, sprawling or weakly rhizomatous shrubs; to rhizomatous shrubs, with stiffly erect aerial shoots

Mature Height: 0.3–5 m

Stem/Trunk: Terete (cylindrical) to subterete branches

Leaves: A high degree of morphological variation is found among the three Hawaiian species: leaves can be deciduous to persistent, ovate to elliptic, papery to leathery, margins serrate to entire

Inflorescence/Flower: Flowers are urn-shaped reddish to greenish developing at leaf axils

Fruit: Berries, bright red, reddish-purple, to yellowish when ripe, 8–15 mm in diameter, flavor is insipid to tasty

Seed: Seeds are small and numerous (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (difficult)

- To propagate by seed, first collect the fruits when they are mature and reddish to yellow-orange in color.
- Keep the fruit soft in a plastic bag until they are cleaned.
- Remove all of the pulp as recommended for small pulpy seeds.
- The seeds can be stored dry in the refrigerator for six months or more, yet they will lose some viability.
- I suggest sowing the seeds soon after cleaning them while they are still fresh. This should result in a higher germination rate.
- Surface sow the tiny brown seeds on clean small black cinder or, for *V. calycinum*, surface sow the seeds on moistened sphagnum moss.
- Keep the seed flats shaded, cool, moist, and under a mist system.

GERMINATION

- Germination can take one to six months for all of the seeds to sprout. Wait until they have six true leaves before transplanting them. They are sensitive to handling, so avoid handling the stems or allowing them to dry out in the process.
- Use a well-draining mix and amend it with black cinder as directed. Then pot them into 2-inch pots.
- Keep the seedlings in a cool, shaded area with partial sunlight.
- Repot the seedlings into new soil and larger pots every six months to a year, using a small amount of 8-8-8 NPK fertilizer, and foliar feed them monthly for healthy growth.

CUTTINGS

- For making cuttings of the low bush *V. dentatum*, take leafy softwood cuttings and follow the directions below. Keep them under a mist system.
- For *V. calycinum* and *V. reticulatum* take pencil-sized, unbranched shoots of the previous years' growth with at least three nodes, and use No. 8 or higher strength of rooting powders.
- Use a cutting mix of 2–3 parts perlite or fine cinder to 1 part potting mix (3:1) in shallow flats.
- Keep the cuttings in a cool, moist environment until they are rooted. Place them in a mist system if available.
- You can expect them to root in three to six months, after which they can be transplanted. Handle the cuttings the same way as the seedlings.

OUTPLANTING

- The plants will be ready for outplanting in one to two years, when the plants have outgrown a 1-gallon pot.
- Plant them in a cool mid- to high-elevation site with well-amended cindery soil.
- Polymer can be added to the planting hole for added moisture and less frequent watering.
- Water the plants for a few months depending on the rainfall. Keep them moist but well-drained for the best results. Native blueberries are shallow-rooted and can be harmed during a drought if they are not watered.
- Fertilize the seedlings every six months with 8-8-8 NPK fertilizer, or foliar feed monthly.

PESTS

- Slugs and ants are the major pests; use the recommended ant bait and horticultural oil sprays to control infestations.
- Watch for slugs eating the seedlings and control them with slug bait.

E

EUPHORBIACEAE
(SPURGE FAMILY)

GENUS:
Antidesma

HAWAIIAN NAMES:
Hame; mehame; ha'ā

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. platyphyllum var. *hillebrandii*	—	end (K) mesic, wet forests to bog
A. platyphyllum tvar. *platyphyllum*	—	end (HI exc. Ni, Ka) mesic forest
A. pulvinatum	—	end (O, Mo, M, and H) dry to mesic forests

Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



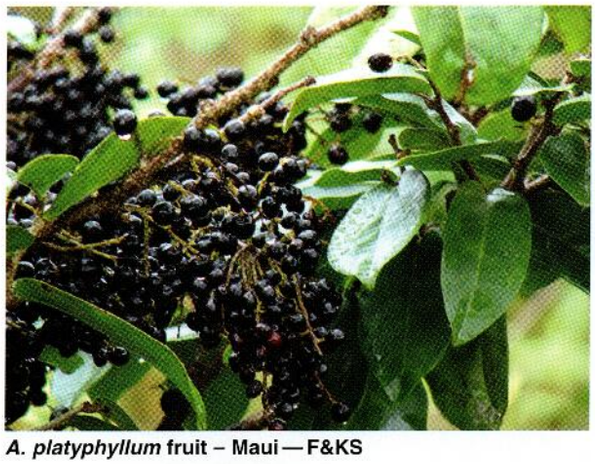
***Antidesma platyphyllum* var. *hillebrandii* fruit — DR**

GENERAL DESCRIPTION

Hame is a common small tree. The large glossy, alternate leaves are papery or leathery in texture. The flowers are dioecious male and female flowers on separate plants and are borne from leaf axils at the branch ends. The roundish reddish-purple fruits are fleshy and contain one to two flat tan seeds. The Hawaiians used the red-brown wood for anvils that were used to beat out olonā fiber, and the red fruit juice used to dye kapa cloth (Wagner et al. 1990).

I have tried to grow many of these seeds for ten years. Some batches of seeds were more viable than others. The wetter years seem to produce seeds with greater viability and faster germination. Prolonged drought forces the trees into producing weak or aborted embryos with very low to no germination. The fact that the trees are dioecious may hinder viable seed production.

Entire Range: Hawaiian endemic
Wild Habitat: Dry, mesic to wet forest, bogs
Habit: Tree



***A. platyphyllum* fruit – Maui — F&KS**

Mature Height: 2–12 m

Stem/Trunk: Woody, branching and watery sap

Leaves: Simple, alternate, distichous (two-ranked) leaves, with pubescence lacking or with only simple hairs, and entire margins, stipulate and petiolate

Inflorescence/Flower: Dioecious (only male or female flowers on a tree), flowers minute, in axillary panicles

Fruit: Drupe, fleshy, compressed, reddish to dark purple, endocarp with conspicuous ridges and depressions, fruit 9–12 mm long and 3–8 mm thick (*A. platyphyllum*); 4–7 mm long and 3–4.5 mm thick (*A. pulvinatum*)

Seed: One to two flat, tan seeds per fruit (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are mature and reddish-purple in color. Keep them moist in a plastic bag. Do not let the pulp dry on the seed; this can promote dormancy.
- Remove the pulp as directed for medium pulpy seeds.
- Soak the cleaned seeds in hand-hot water for twenty-four to forty-eight hours; then air-dry the seeds.
- Start the seeds fresh on a leveled mix of 3 parts perlite to 1 part potting mix (3:1), add ½ inch of mix on top of the seeds.
- Water the seeds in and then water every other day; keep them in a covered area.

GERMINATION

- Germination may take from three to nine months for all viable seeds to sprout. Wait until at least four true leaves develop before transplanting.
- Transplant into 3-inch-tall pots for proper root growth. Use a well-draining soil mix and add a small amount of 8-8-8 NPK fertilizer.
- Keep the seedlings in an area that is shaded to partial sun.
- Repot them into larger deep pots and add new soil every four to six months as needed for a healthy root system.
- Foliar feed your plants every month for strong and fast growth.
- Move the trees gradually into more sun to harden them off.

OUTPLANTING

- It may take one to two years before your hame are ready for outplanting. Watch for when the trees have outgrown a 1–2-gallon pot and are growing strong.
- Choose a location in partial sun and with a well-draining soil amended as directed.
- Water them in, then water weekly checking on the hame tree, and watering when it is dry.
- Fertilize your trees every six months with 8-8-8 NPK fertilizer or foliar feed monthly.
- This tree is worth the extra time and care needed to keep the plant healthy and growing.

PESTS

- Keep ants and weeds away from the base of the tree to avoid insect damage. Apply ant bait and treat for associated insects as recommended.
- The Chinese rose beetle may eat the leaves and make them unsightly, but they will not kill the plant.

E

EUPHORBIACEAE

(SPURGE FAMILY)

GENUS:

Claoxylon

HAWAIIAN NAMES:

Po'olā; laukea

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
C. sandwicense	—	end (HI exc. Ni, Ka) dry to wet forests

Partial Sun

Range
Hawaiian Endemic

Description
shrub or tree

Propagation
seeds



***Claoxylon sandwicense* flowers and fruit – Hawai'i — SP**

GENERAL DESCRIPTION

Po'olā is most commonly found on Kaua'i and O'ahu, as shrubs to small trees with spindly stems and young hairy shoots. The bright green, finely toothed leaves are 3 inches wide and 6 inches long and are clustered at branch ends. Small yellowish-green flowers are monoecious both male and female flowers on the same tree. They develop in bunches or alone on short spikes along the twigs from the leaf axils. The tripartite green capsules are purple when mature and contain two to three round tan seeds.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Shrubs or trees

Mature Height: 2–5 m

Stem/Trunk: Soft wooded, watery sap, sparsely branching, with new growth tomentose (hairy)

Leaves: Leaves are simple, alternate, large and variable from oblong, oblanceolate, to narrowly obovate to elliptic; 9–24 cm long by 4–7 cm wide; upper surface mostly free of hairs or glands, lower surface of leaves tomentose (hairy), serrate margins, petiolate with minute, deciduous stipules

Inflorescence/Flower: Monoecious, corolla absent, solitary or in clusters, axillary, male flowers in clusters with numerous stamens, three-lobed calyx, without a nectary disc or glands; female flowers solitary occurring on pedicels, with a three-lobed triangular calyx.

Fruit: The fruit are green capsules that ripen to purple; they are depressed and globose, about 5 mm long and 6 mm in diameter, and deeply grooved into thirds

Seed: The seeds are tan, globose, and rugose (appear sculpted like a brain) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are ripe and purple; keep them in a dry paper bag until it is time to clean.
- Separate the small tan seeds from the capsules by hand.
- Start the seeds fresh, soak them in tap water for one hour. The viable seeds will sink; discard the seeds that float.
- Sow seeds in a shallow flat of leveled mix made up of 3 parts perlite to 1 part potting mix (3:1), then add ½ inch of mix on top of the seeds.
- Keep the flat in a covered area to control the moisture; keep moist not wet.

GERMINATION

- Germination may take one to three months for all viable seeds to sprout; wait until at least two true leaves develop.
- Transplant them into 3- to 4-inch pots of well-draining soil mix.
- Keep them in a shaded place for two weeks, and then move them into the partial sun to harden them off for outplanting.
- Foliar feed the plants once a month to strengthen them.
- Repot them every four to six months into tall larger pots adding new mix and 8-8-8 NPK fertilizer.

These trees are best grown from seeds; seedlings that have been dug up and cuttings both work well. However, they take longer to grow a strong healthy plant suitable for outplanting. In order to take successful cuttings the parent plant must be growing vigorously and not stressed in any way.

OUTPLANTING

- The seedling may be ready for outplanting in six months to a year or when it has outgrown a 1-gallon pot.
- Choose a site in partial sun with well-draining soil; amend the site as recommended.
- Water in your laukea, then water them every two weeks or if the area dries out, until the plants are established.
- Foliar feed the plants every three to six months for healthy growth.

PESTS

- Ants can be pests in your garden; they can occur at the base of the tree and will farm scale and mealybugs; ants and their associated pests can be controlled as recommended.



***C. sandwicense* habit — F&KS**

E

EUPHORBIACEAE
(SPURGE FAMILY)

GENUS:
Euphoribia (Syn: *Chamaesyce*)

HAWAIIAN NAMES:
'Akoko; 'ekoko; koko; kōkomālei

SPECIES:
There are twenty eight endemic species, and all are considered threatened or endangered; they are found on all of the main Hawaiian Islands.

Full Sun – Partial Sun[1]

Range
Hawaiian Endemic

Description
sprawling subshrubs to small tree

Propagation
seeds and cuttings

1: Sun requirements differ for each species.



***Chamaesyce celastroides* var. *kaenana* seed capsules – O'ahu — SP**

GENERAL DESCRIPTIONS

'Akoko is a very adaptable species and can grow as sprawling prostrate mats, subshrubs, to small trees. In dry coastal locations the plants are low-growing with smaller gray leaves that reflect the strong sunlight; salt spray and their stems store water for drier days. The 'akoko from higher elevations take on a tree-like growth with larger 6-inch long dark green, leathery leaves adapted to more moisture and shade. The seeds are even different: coastal 'akoko have tiny mucilaginous seeds, whereas inland species have larger drier seeds. These plants can become weedy in a nursery setting and when outplanted, which is a good thing for the plants; the seedlings can be transplanted or easily potted for elsewhere.

Entire Range: Hawaiian endemic

Wild Habitat: Open, dry, mesic, diverse mesic, to wet forests and rarely bogs; coastal vegetation, strand vegetation at sea level; dry shrubland, open subalpine, arid volcanic cliffs, and cloud-swept summit ridges

Habit: Herbs, subshrubs, large shrubs, or small trees

Mature Height: 0.5–9 m in height

Stem/Trunk: Herbaceous to woody, often with milky sap

Leaves: Leaves are simple, opposite, decussate (opposite leaves set at right angles to previous pair) or distichous (two-ranked, two opposite rows in the same plane), glabrous (smooth) or pubescent (with hairs), margins entire or serrate (toothed), leaf base usually asymmetrical, sessile (without a stalk) or subsessile, and with well-developed stipules.

Inflorescence/Flower: Monoecious, pistillate flowers (female) solitary, sepals and petals absent, ovary with three carpels and one ovule per cell; staminate flowers (males) in fives or cymules, with one to several flowers, sepals and petals absent

Fruit: Capsule with a persistent axis (rachis)

Seed: Seeds small (0.15 cm diameter) to larger (2.5 cm diameter), without an appendage near the seed hilum (ecarunculate), rounded to angled, seed coat mucilaginous, smooth to rugose (appears sculpted, like a brain), or marked with transverse or longitudinal grooves, with a copious endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the capsules when they are dry and turn brown or red; keep them dry in a paper bag until you are ready to clean and plant them.
- The seeds should be cleaned as directed for small dry seeds.
- Seeds can be stored up to four years in desiccation or kept dry in the refrigerator.
- Surface sow the small tan seeds on a dry mix of 3 parts perlite to 1 part potting mix (3:1); water the seeds in.
- For larger seeds cover with ½ inch of the same mix and water them in.
- Keep them in a covered, protected area until they germinate, then move the seedlings into an area with more sunlight.
- Water every other day or every two days. Keep the high elevation species, such as *E. remyi* and *E. rockii*, wetter.

GERMINATION

- Germination may take three days to two months for all viable seeds to sprout. They will be ready to transplant when at least four true leaves appear (in about a month).
- Use a well-draining mix for the drier and lower elevations species by adding more cinder or perlite. Use a wetter mix for the higher elevation species by adding more potting mix to the well-draining mix.



Chamaesyce celastroides **four month-old seedling – NTBG nursery — KLR**

- Keep the seedlings in a shaded and protected area, and then move the lower elevation species into full sun and the high elevation species into partial sun.

CUTTINGS

- Take the semi-hardwood to softwood cuttings and remove all of the lower foliage, keeping the cuttings moist in a sealed plastic bag.
- Start the cuttings as fresh as possible, in a shallow flat of leveled mix made up of 3 parts perlite to 1 part vermiculite (3:1), or in 3 parts black cinder to 1 part potting mix (3:1).
- For semi-hardwood cuttings use rooting powder No. 3; for softwood cuttings use rooting powder No. 1 or none, depending on how green the stems are.
- Keep in a shaded, covered area and water every other day.
- Transplant the rooted cuttings in two to six months, which all depends on the stored food in the stems of the plant material collected.
- Pot the cuttings into well-draining soil and handle them the same as described for the seedlings.

OUTPLANTING

- 'Akoko may be ready for outplanting in six months to a year or when it outgrows a 4-inch pot for the low-growing 'akoko, and a 1-gallon pot for the taller tree 'akoko species.
- Choose a site in full to partial sun depending on which species; the higher elevation species need more moisture and shade, and the coastal species need full sun and drier locations.
- Fertilize the plants about every six months for healthy growth.
- The 'akoko seeds will freely sprout and grow in the planting area or even in the pots; unwanted seedlings are easily potted up or can be relocated.

PESTS

- If ants infest your plants, control them from the base of the plant as recommended.
- Root mealybugs can be a problem. Control them with systemic pesticides (soil drench), or apply horticultural oils.

E

EUPHORBIACEAE

(SPURGE FAMILY)

GENUS:
Euphorbia

SPECIES	STATUS	HAWAIIAN RANGE
E. haeleeleana	—	end (K, O)



***Euphorbia haeleeleana* flowers — JO**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds

GENERAL DESCRIPTION

A small tree 9–35 ft tall with thick, lush branches that end bluntly. The papery leaves are alternate, resembling a plumeria leaf. The large flowers develop at the branch ends and are dioecious (male and female flowers are on separate trees) needing both male and female trees to produce viable seeds. Dry brown capsules, which contain one mottled dark-brown seed. At present there are 15 known populations, found only on the north-west coast of Kauai and Oahu.

Their wild habitats are steadily being degraded by hungry feral goats, pigs, deer and the rapid spread of introduced plants. These are the main causes of decline of so many of the native plants and animals in the wild.

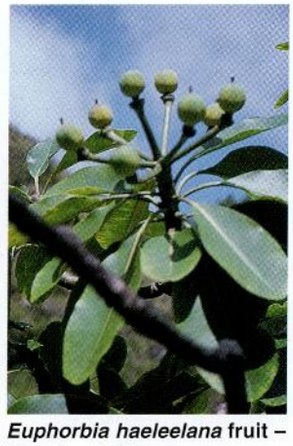
Entire Range: Hawaiian endemic
Wild Habitat: Diverse mesic forests to dry forests
Habit: Small tree
Mature Height: 3–14 m
Stem/Trunk: Thick succulent branches, terminating in a blunt apex, prominent leaf scars on young branches
Leaves: Leaves alternate, papery, elliptic, 12 cm long by 5 cm wide; margins entire, leaf

surface without hairs or glands, occasionally with hairs; leaf stalks 2–4 cm long, and no stipules

Inflorescence/Flower: Dioecious flowers in axillary cyathia with glabrous involucre, and eight to nine dark brown (sometimes mottled) involucral glands, which are hirsute (hairy) below; male flowers numerous; ovary three-celled, one ovule per cell; three styles

Fruit: Capsules, drying to a brown color, globose, about 12 mm in diameter, hirsute (hairy), with a gynophore (central stalk)

Seed: Seeds dark brown, mottled, ovoid, angled 7–9 mm long about 5 mm wide (Wagner et al. 1990)



***Euphorbia haeleelana* fruit – Kaua'i — KRW**

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the capsules when they are dry and brown; keep them in a dry paper bag until it is time to clean.
- Separate the spotted, dark brown seeds from the capsules by hand or as directed for medium dry seeds.
- Start the seeds fresh, soak them in tap water for one hour. The viable seeds will sink; discard the seeds that float.
- Sow seeds in a shallow flat of leveled mix made up of 3 parts perlite to 1 part potting mix (3:1), then add ½ inch of mix on top of the seeds.
- Keep the flat in a covered area to control the moisture, and keep the mix on the dry side.

GERMINATION

- Germination may take one to three months for all viable seeds to sprout; wait until at least two true leaves develop.
- Transplant them into 3–4-inch pots of well-draining cindery soil mix.
- Keep them in a shaded place for two weeks, and then move them into full sun to harden them off for outplanting.
- Foliar feed the plants once a month to strengthen them.
- Repot them every four to six months into tall larger pots adding new mix and 8-8-8 NPK fertilizer.
- These trees are best grown from seeds; seedlings that have been dug up and cuttings both work well. However, they take longer to grow into a strong healthy plant suitable for outplanting. In order to take successful cuttings the parent plant must be growing vigorously and not be stressed in any way.

OUTPLANTING

- The seedling may be ready for outplanting in six months to a year or when it has outgrown a 1-gallon pot.
- Choose a site in full to partial sun with well-draining soil; amend the site as recommended.
- Water in the seedlings, then water them every two weeks; if the area dries out, water until the plants are established.
- Foliar feed the plants monthly for healthy growth.

PESTS

- Ants can be pests; they can occur at the base of the tree and will farm scales and mealybugs; ants and their associated pests can be controlled as recommended.

E

EUPHORBIACEAE

(SPURGE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Flueggea	**Mēhamehame**	*F. neowawraea*	E	end (K, O, Mo, M, H)



Flueggea neowawraea **fruit – Kaua'i — SP**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds

GENERAL DESCRIPTION

Mēhamehame is one of the most threatened and tallest trees in dry to mesic forests on the Hawaiian Islands. The tree is dioecious, needing both male and female trees to produce viable seeds. The thin, opposite leaves with their upper side a dark green, and their lower sides paler green, and with distinct pinnate veins. Tiny, greenish flowers grow in tight clusters at the leaf axils. Reddish, round, pulpy fruit hang on by a short stalk, and have two to four small seeds inside. Older trees form buttress bases and have dark, reddish-brown wood. The seedlings are attacked by black coffee twig borers that lay their eggs into the pith of the young tree and kill it from the bite up to the tip. If this happens, cut off the affected portion and destroy it. The Chinese rose beetle also causes problems by eating holes into the leaves, so many holes at times that the plant cannot grow properly because of the lack of photosynthesis conducted by the ragged leaves. Few, if any, seedlings are known in the wild, and the mature trees are considered "living dead" because like so many other native plants, they do not have young seedlings that can withstand the threats and survive in the wild. Only the mature trees remain and they will die off eventually and the species will go extinct.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forest
Habit: Tree
Mature Height: 30 m
Stem/Trunk: Bark pale, brown, rough, and scaly; lenticels abundant and whitish; shoots glabrous; sap watery; sapwood reddish-brown; heartwood black
Leaves: Leaves simple, alternate, pinnately veined, and stipulate. Leaves thin and papery, upper surface green, lower surface pale green, glaucous, ovate-elliptic, 4–14 cm long by 2–9 cm wide, glabrous (without hairs or glands), margins entire, apex acute, and petioles (leaf stalks) 0.5–2 cm long
Inflorescence/Flower: Dioecious, actinomorphic, in axillary clusters, male flowers on short stalks (3–4 mm long) have five sepals that are green with brownish tips, and somewhat spatulate, about 2 mm long; female flowers on short stalks (5–14 mm long), five unequal sepals, and a superior ovary
Fruit: Capsule reddish-brown to black when ripe, juicy, globose, 3–6 mm in diameter, subtended by persistent sepals borne on pedicels (stalks) 5–20 mm long
Seed: Seeds two to four per capsule, slightly curved 2–4 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the ripe fruit when they are reddish-black in color, and keep them in a plastic bag until they are cleaned and sowed.
- If the pulp is dried onto the seeds, soak them for one hour in water to soften them.
- Separate the seeds from the pulp as directed for medium pulpy fruit.
- Start fresh seeds as soon as possible as they will lose all viability by desiccation, but can be stored in the refrigerator, keeping them dry.
- Pretreat the seeds by soaking them in hand-hot water or tap water for one hour. The viable seeds will sink.
- Sow the seeds in a mix of 3 parts perlite to 1 part potting mix (3:1) with ½ inch of mix added on top of the seeds. Then water the seeds in.
- Keep the flats in a covered, shaded area.

GERMINATION

- Germination may occur in twenty-six days to two months; wait until at least four true leaves develop (which should be about two months) to transplant.
- Transplant them into 3-inch-tall pots, which gives the roots room to grow. Use a well-draining soil mix.
- Repot them into taller pots and add new mix in six to eight months.
- Keep them in a partially shaded area for two months, and then move them into full sun to harden them off.
- For potted plants use a light solution of systemic pesticide to prevent twig borer infestations and beetle damage. Follow the directions on the label.

OUTPLANTING

- Plants may be ready for outplanting in one to two years, or when they have outgrown a 1–2-gallon pot.
- Choose a protected site from strong winds, with well-draining soil in full to partial sun.
- Surface sow systemic pesticide around the plant and then water it in to prevent damage from borers and beetles.
- Foliar feed your tree monthly and use small amounts of 8-8-8 or 14-14-14 NPK fertilizer every six months or as needed.
- Monitor your plants regularly and check for pests, diseases, or distress.
- Because this species is monoecious, both female and male trees need to be planted near each other to produce viable seeds.

PESTS

- Pests include the black twig borer, rose beetles, and ants, which also farm scales. These are troublesome pests; control each of them according to the specific recommendations provided.

E

EUPHORBIACEAE

(SPURGE FAMILY)

GENUS:

Phyllanthus

HAWAIIAN NAME:

Pāmakani māhū, pāmakani

SPECIES	STATUS	HAWAIIAN RANGE
P. distichus		end (K, O, Mo, L, M) dry shrubland to mesic forests



P. distichus **—F&KS**

GENERAL DESCRIPTION

An upright to low sprawling shrub, commonly found growing on slopes or ridges in dry to mesic forests.

Their small flowers have no petals and are each monoecious (male or female on the same plant) or dioecious (male and female flowers growing on separate plants). They have alternate, simple leaves 1 to 3 inches in length. Some plants have brick red new leaves that turn a glossy green with age.

The pāmakani māhū is deciduous, losing their leaves on the arrival of fall or a dry season. I feel with its little star flowers, beautiful reddish leaves and low growth habit, it could work in a Hawaiian landscape. I suggest planting among other natives, because it loses it foliage at times, leaving it unsightly if planted alone.



***P. distichus* male flowers —F&KS**

Entire Range: Hawaiian endemic.
Wild Habitat: Common in mesic forest, often on steep slopes or ridge tops, sometimes in dry shrubland.
Habit: Shrub to Subshrub shrubs 3 feet tall; stems erect or when more than 1m long usually scandent, branching nonphyllanthoid, main stem leafy and bearing flowers.
Mature height: 1-8 feet, 6 feet spread.
Leaves: Leaves distichous, variable in shape, lanceolate to elliptic, sometimes ovate or broadly elliptic, glabrous or with a few widely scattered hairs, apex acute to rounded, base rounded or sometimes slightly cordate, petioles 0-3(-4)mm long, stipules cordate, 1-2mm long, deciduous.
Flowers/inflorescence: Staminate flowers in dense, axillary, bracteate cymes, pedicels 2-4mm long, calyx lobes 6, ca. 1-1.3mm long, nectary disk 6-lobed, stamens 3, filaments distinct; pistillate flowers few or solitary in the leaf axils, sometimes surrounded by staminate flowers, pedicels 4-12mm long, calyx 6-lobed, ca. 3mm long, nectary disk circular, scarcely lobed, styles distinct, deeply bifid.
Fruit/seeds: Capsules green to brown, depressed-globose, 3-3.5mm in diameter, explosively dehiscent; seeds angled, ca.1mm (Wagner et al.1990)

PROPAGATION AND CULTIVATION

- To propagate by seed, first collect the capsules when they are dry and turn brown; keep them dry in a paper bag until you are ready to clean and plant them.
- Remove the small angled seeds from the capsules by hand.
- Seeds can be stored dry in the refrigerator for a few years.
- Surface sow the small tan seeds on a dry mix of 3 parts perlite to 1 part potting mix (3:1); water the seeds in, then every two days.
- Keep them in a covered, protected area until they germinate, then move the seedlings into an area with more sunlight, for healthy growth.

GERMINATION

- Germination may take three days to two months for all viable seeds to sprout. They will be ready to transplant when at least four true leaves appear (in about a month).
- Transplant them into 3- to 4-inch pots of well-draining cindery soil mix.
- Keep them in a shaded place for two weeks, and then move them into the full sun to harden them off for outplanting.
- Foliar feed the plants once a month to strengthen them.
- Repot them every four to six months into tall larger pots and add new media mix adding 8-8-8 NPK fertilizer. Use a well-draining soil mix.

CUTTINGS

- Take the semi-hardwood to softwood cuttings and remove all of the lower foliage, keeping the cuttings moist in a sealed plastic bag.
- Start the cuttings fresh, as soon as possible, in a shallow flat of leveled mix made up of 3 parts perlite to 1 part vermiculite (3:1), or in 3 parts black cinder to 1 part potting mix (3:1).



***Phyllanthus distichus* female flower — F&KS**

- For semi-hardwood cuttings use rooting powder No. 3; for softwood cuttings use rooting powder No. 1 or none, depending on how green the stems are.
- Keep in a shaded, covered area and water every other to every two days.
- Transplant the cuttings in about two to six months, which all depends on the stored food in the stems of the plant material collected.
- Pot the cuttings up into well-draining soil and handle them the same as described for the seedlings.

OUTPLANTING

- Pāmakani māhū may be ready for outplanting in six months to a year or when it outgrows a 1-gallon pot.
- Choose a site where pamakani can spread-out in full to partial sun with well-draining soil; amend the site as recommended.
- Water them in, then water every two weeks or whenever the area dries out, until the plants are established.
- Fertilize the plants about every six months for healthy growth.
- The seeds will freely sprout and grow in the planting area or even in the pots; unwanted seedlings are easily potted up or can be relocated.

PESTS

- If ants infest your plants, control them from the base of the plant, as recommended.
- Root mealybugs can be a problem. Control by applying a light solution of neem oil, soap spray, or horticultural oil.

FABACEAE

(LEGUME OR PEA FAMILY)

F

GENUS:

Acacia

HAWAIIAN NAMES:

Koa; koai'a; koai'e; koa'ohā

SPECIES	STATUS	HAWAIIAN RANGE
A. koa	—	end (HI exc. Ni, Ka)
A. koaia	V	end (O?, HI exc. Ni, Ka)



Acacia koa – Kerin's yard — KLR

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds

GENERAL DESCRIPTION

Koa is the second most dominant tree of the upper dry to wet forests of Hawai'i ('Ōhi'a being the first). Koa is easily recognized by its 50–115 feet stature and spreading branches. What look like gray-green sickle-shaped leaves are really modified leaf stalks or phyllodes. The seedlings and juvenile trees also can have finely divided darker green compound leaves, which change into phyllodes with maturity. The lemon yellow flowers are small puffs forming near the branch ends, as do the flat thin pods that turn brown when fully developed. Each pod contains six to ten shiny flat black seeds. These are often eaten by seed weevils that feed on the embryos making the seeds nonviable. Recently in my yard, I have observed introduced rose-ringed parakeets eating the seeds through the pods. The two different native species can be identified by a combination of characteristics but the most obvious one is how their seeds are arranged in the pods. If they are horizontally arranged it is

A. koa and if the seeds are arranged vertically, it is *A. koaia*.

One of the many things I like, in addition to the beauty of the koa, is the aroma from the nitrogen-fixing fungus associated with the roots. You may notice it when digging near a plant or when you are planting a seedling because it comes from the roots and the surrounding soils. Even the seeds and tiny seedlings have this odor when handled. The highly prized koa wood is reddish-brown with lighter tan streaks. It is used for traditional crafts, lumber, and woodworking. These trees are used in reforestation and it has great potential for further use in the commercial landscape industry in the Hawaiian Islands and possibly other tropical regions. A myth that I often hear is that koa cannot grow at the lower elevations. I have healthy *A. koa* and *A. koaia* trees growing in my yard at 200-300 ft elevation and they are vigorous and do not demonstrate elevation problems. I have seen fungal root problems result from too much moisture in the soil.

Please give koa trees a chance in your landscaping. They are very striking trees with their gray-green sickle-shaped phyllodes. They tolerate heavy pruning so they can be kept smaller, and a big plus is that the koa tree adds nitrogen to the surrounding soil, improving soil quality and health.

Entire Range: Hawaiian endemic

Wild Habitat: Lowland to upper dry, mesic, and wet forests

Habit: Branching tree

Mature Height: 35 m

Stem/Trunk: Beautiful grained (reddish-brown with tan streaks, hardwood, bark grayish to brown; trunk can reach 1–2 m in diameter) in older trees

Leaves: Mature leaves are sickle-shaped phyllodes, which are modified leaf stalks, and pale grayish-green; new leaf growth is bi-pinnately compound leaves, green and of various sizes

Inflorescence/Flower: Flowers are perfect, about 2 mm long and mimosaceous (like a Mimosa). The corolla is cream colored, the stamens curled, and more than twice as long as the corolla. The flower heads are in axillary racemes, and sometimes congested into leafy terminal panicles. The ovary is superior and pubescent

Fruit: Flattened, oblong pods, sometimes with constrictions between seeds, and with straight sutures (8–30 cm long and 0.8–2.5 cm wide)

Seed: Seeds are ellipsoid, flattened laterally, about 10 mm long by 5 mm wide, and a dark brownish-black (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

It is better to propagate large trees with wide-spreading canopies from seeds rather than from cuttings or air layers. Seedlings provide a stronger, healthier root system, allowing the tree to obtain better nutrition and more stabilization, especially during strong winds.



***Acacia koaia* flowers and seeds – Hawai'i — DL**

SEEDS (easy)

- To propagate from seed, first collect the brown pods; remove the black seeds from pods as soon as possible to reduce insect damage from seed weevils.
- If insect damage is a problem, soak the seeds in water; discard the seeds that float as they are nonviable.
- The seeds can be stored in desiccation chambers, at room temperature, or in refrigeration for up to ten years.
- For the fastest and highest germination rates, scarify the seeds as recommended.
- For large numbers of seeds, soak in hand-hot or tap water for twenty-four hours. Not all of the seeds will swell (the swelled seeds will germinate first), and germination will occur between eight days to one year.
- Place the seeds flat and ¼ inch apart in a leveled mix of 3 parts perlite to 1 part potting mix (3:1), and then cover the seeds with ¼ inch of additional mix.



***Acacia koa* seeds germinating – Hawai'i DOFAW nursery — DR**

- Water the seeds in, then water every other day. Keep them in a covered area.

GERMINATION

- Germination may take from eight days to two months for all scarified seeds to sprout. It can take four to twelve months for all soaked seeds to germinate.
- Transplant the seedlings into 4-inch pots (or taproot pots) when two to four true leaves develop; use a well-draining mix.
- Keep the potted seedlings in a covered, shaded place for a few weeks, and then move them into more sun.
- Repot the plants into 1-gallon pots in four to six months; do not allow your trees to become root-bound in the pots at any time because this causes an unhealthy root system which may result in the early death of the tree.
- Move the plants into full sun to harden them off before outplanting them.
- *A. koa* is a faster-growing, stronger tree than *A. koaia*. The health of the parent plant determines how healthy the seedlings will be.

OUTPLANTING

- Both koa and koai'a grow well at about 200 feet elevation. They are low-maintenance trees and attractive landscape components.
- The trees will be ready for outplanting in about one year, when they have outgrown a 1- to 2-gallon pot.
- Choose a site in full to partial sun, and if it is a windy area, provide support to the young trees until they become established and stable.
- Amend the planting hole as recommended for soil to be well-draining, and fertilize with a small amount of 8-8-8 or 10-10-10 NPK Fertilizer.
- If the plants have become root-bound, gently loosen the circling roots to avoid unhealthy growth. Try to straighten the roots out into the planting hole. They will tolerate some root pruning (never remove more than half of the root mass).
- Water them weekly until they become established, then water only in times of prolonged drought.
- Koa can be pruned back to keep the size of the tree manageable in small spaces.
- A good companion for the koa tree is the native sandalwood.

PESTS

- Koa can attract many pests such as ants, scale, and red spider mites. If they become infested with these control them as directed.
- Black twig borers lay their eggs into the stem of the young plants, and then the larvae eat the pith, killing or damaging the young plants. If you discover black twig borers in your koa, cut off all affected parts. What remains of the plant will sometimes grow back, depending on the age of the plant. Also apply a systemic pesticide, following the directions on the label.
- Seed weevils and rose-ringed parakeets eat the seeds, rendering them nonviable in most cases.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:

Caesalpinia

HAWAIIAN NAMES:

Kākalaioa

COMMON NAMES:

Gray nickers, Hawaiian pearls

SPECIES	STATUS	HAWAIIAN RANGE
C. bonduc		ind (HI exc. L, Ka) dry open shrubland
C. kavaiensis (syn: *Mezoneuron*)		

Full Sun

Range
Indigenous

Description
large creeping shrub

Propagation
seeds



C. bonduc —F&KS

GENERAL DESCRIPTION

A large creeping shrub that reaches 20 ft, in length, sprawling on the ground or climbing over vegetation in open dry lowlands throughout the Pacific.

Stems are covered with sharp curved prickles as are their twice–compound leaves and seed pods.

The hard, roundish gray 1 inch seeds, known as nickernuts or gray nicker are buoyant and durable enough to be dispersed by ocean currents (seabeans). I have noticed that quite often the seeds are still viable after 20+ years in storage and/or after long distances afloat in ocean water.

The gray nicker is best known for its seeds that have been used over the centuries in crafts and acknowledged for its many medicinal medicines.

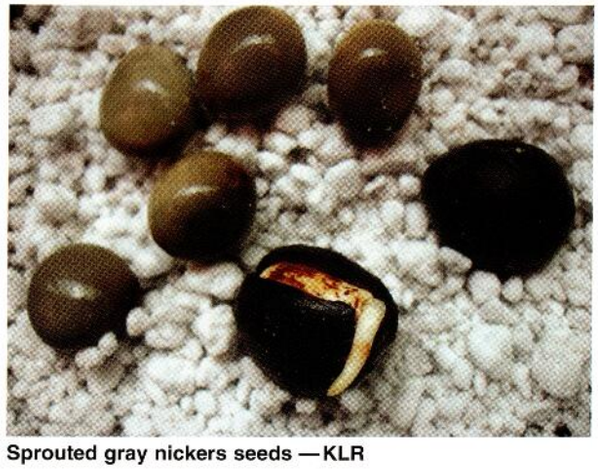
Kākalaioa could be regarded as a weedy pest in a landscape due to their spiny and fast growing sprawling nature.

Range: Indigenous to Hawai'i
Wild Habitat: Dry disturbed lowland areas
Habit: Armed climbing shrubs or shrubby trees
Mature Height: 18 to 20 feet in length.
Stem/Trunk: Scrambling bush with prickles on round branches.
Leaves: Leaves are shiny with 3 to 9 pairs of opposite bipinnate leaflets, each 2 - 2.5 inches in length.
Inflorescence/Flower: Small yellow to orange 5-petaled flowers are unisexual forming on crowded axillary racemes.
Fruit: The fruit is a 2 to 3 inch oblong seedpod, slightly swollen, armed with pickles containing one to three seeds.
Seed: Smooth and shiny seeds are pale gray when mature, subglobose to ovoid 1 inch in diameter (Wagner et al. 1990).

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate from seed, first collect the pods when they are dry and brown. Cautiously remove the seeds by hand with gloves to avoid their many prickles.
- Soak the seeds in tap water for twenty-four hours, viable seeds should sink.
- For fast even germination, scarify seeds. Soaking only will lead to varied germination rates.
- To scarify, nick each seed with a file or hand clippers; do not soak in water after nicking as seeds take up too much moisture rapidly and are more at risk to rot.



Sprouted gray nickers seeds —KLR

- Place the treated seeds in individual tall 4-inch pots or all together in 6- to 8-inch pots.
- Sow in a mix of 3 parts perlite to 1 part potting mix (3:1) with an additional inch of mix on top; keep seed mix on the dry side.
- Keep them in a covered, protected area to control the moisture, watering three times a week.

GERMINATION

- Germination can occur as soon as five days for pretreated seeds and up to a year for untreated seeds (not soaked or scarified).
- Seedlings have long vine like growth. When they form four true leaves, transplant them into tall 6-inch or taproot pots using a well-draining mix; poor drainage and too much moisture in the mix will rot the roots.
- Nickers have fast growing tap roots that easily become root-bound; repot in a timely manner.
- Keep newly potted seedlings in the shade for a week or so, and then move them into full sun to harden them off.
- Water when it is dry; fertilize if needed. Can be weedy in a landscape.
- In a few months or when twice as tall as its pot. Transplant your gray nicker into a larger 1 gallon pot, using a well-draining soil mix.

OUTPLANTING

- Kākalaioa will be ready for outplanting when outgrown a 1-gallon pot, in six to nine months.
- When outplanting select a site where the plant can freely sprawl on the ground or climb.
- Choose a dry location in full sun with well-draining soil. Amend the soil with 8-8-8 fertilizer.
- Water in the plant at first, then only water during times of prolonged drought.

PESTS

- Ants may farm insects at the base of the plant. In each of these cases, control as directed.
- Mealybugs can infest the roots and stems. Use horticultural oils to control them.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:
Canavalia

HAWAIIAN NAMES:
ʻĀwikiwiki; puakauhi

SPECIES	STATUS	HAWAIIAN RANGE
C. galeata	—	end (O)
C. hawaiiensis	—	end (L, M, H)
C. kauaiensis	—	end (K)
C. molokaiensis	E	end (Mo)
C. napaliensis	V	end (K)
C. pubescens	V	end (Ni, K, L, M)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
climbing vine

Propagation
seeds



***Canavalia molokaiensis* flowers – Molokaʻi — SP**

GENERAL DESCRIPTION

ʻĀwikiwiki are perennial clambering vines growing up trees or growing along the ground in dry to mesic forests. The papery three parted leaflets are wider than they are long and grow along the thin stems. Pinkish to dark-purple flowers (species specific) are bean shaped and develop from the leaf axils, as do the long, flat-ridged, brown pods. The pods contain two to six large, 1-inch-long, reddish-brown seeds. These seeds arrived in the Hawaiian Islands by flotation, but they have since lost this ability. Loss of dispersibility for a wide array of species is a trend found in many island archipelagos including Hawaiʻi (Carlquist 1980; Grant 1998). Leis are made from the colorful flowers and smooth seeds. This attractive vine can be used as a ground cover or for growing up a fence or into a strong canopy tree, koa for example.

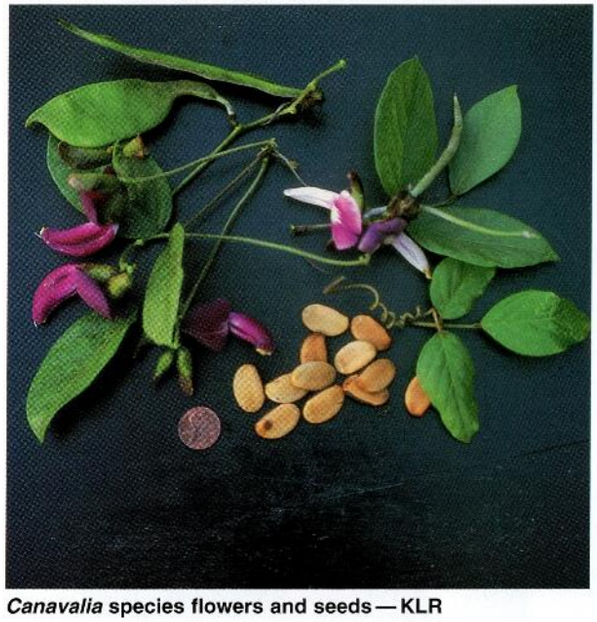
Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Perennial climbing vine
Mature Height: Not applicable
Stem/Trunk: Thin, twining, branching vines

Leaves: Leaves pinnately trifoliolate (with three leaflets), leaflets can be somewhat leathery (*C. pubescens*), to papery; leaflets, often ovate, the lateral ones often asymmetrical, with minute stipules

Inflorescence/Flower: Pea-like flowers are pink to purple, and grow from the leaf axils

Fruit: Pods with two to six seeds

Seed: Large seeds about 1 inch (2.54 cm) long, slightly flattened, and reddish-brown (Wagner et al. 1990)



***Canavalia* species flowers and seeds — KLR**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the pods when they are dry and brown. Remove the seeds as soon as possible to prevent any damage from seed weevils. It is common for seed weevils to bore into the pods and feed on the seed embryos.
- Seeds can be stored in a desiccation chamber, at room temperature, or refrigerated for up to ten years.
- Seeds can be soaked to soften the hard seed coats, and then scarified. Or, only scarify the seeds.
- Do not scarify the seeds and then soak them in water, or you will drown and kill the embryo if they are soaked for more than a few minutes.
- Plant the seeds in tall, individual 3–4-inch pots or together in 6–8-inch pots.
- Place the seeds flat onto a mix of 3 parts perlite to 1 part potting mix (3:1), 1 inch apart, then cover the seeds with ½ inch of additional mix.
- Water the seeds in, then water every other day to every two days. Do not keep the mix soaking wet because the seeds will rot.
- Keep the pots in a covered area to protect them from heavy rains.

GERMINATION

- If scarified, all viable seeds will sprout in about five days. If the seeds are only soaked, germination can vary and take months to germinate.
- Transplant them into 5–6-inch pots, using well-draining cindery soil.
- These are fast-growing vines that require repotting every three to six months into larger pots with additional new soil.
- Move the vines into an area with full to partial sun to harden them off for outplanting.

OUTPLANTING

- These vines will be ready for outplanting in three to six months, when the plants have outgrown a pot between 6 inches and 1 gallon in size.
- Choose an outplanting site that is in full to partial sun with amended well-draining soil; the mesic species require more shade (*C. molokaiensis* and *C. galeata).*
- Choose a site where the vine can grow over or up a tree, fence, or trellis.
- Water in the vines and then water weekly if the weather is dry. Fertilize every six months or foliar feed monthly for more flowers.

PESTS

- Pests can include red spider mites, which take up residence on the undersides of the leaflets. To control them, spray with horticultural oil.
- To help prevent seed weevil damage, treat the soil around the plant with a systemic pesticide before the plants bloom. Or collect the seeds and clean them in a timely manner to prevent extensive damage.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Erythrina	Wiliwili	*E. sandwicensis*	—	end (HI) coastal to lowland dry forest

Full Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds, cuttings, and air-layering



***Erythrina sandwicensis* flowers – Kaua'i — RY**

GENERAL DESCRIPTION

Wiliwili is a large, dry-forest tree, 18–45 feet tall, with thin yellowish-orange bark. The leaves fall off during flowering and prolonged drought to conserve water loss. Flowers form in clusters at the branch ends, ranging in color from peach to light green, very attractive trees when they are in full bloom. The hairy brown pods are twisted when mature, giving the wiliwili (Hawaiian for "twist-twist") its name. Hawaiians used the soft, whitish wood for floatation purposes (such as surfboards, net floats, and for the outriggers on canoes). This is a very fast and easy to grow tree, which does well in dry lower elevations. The bright red-orange to purple bean-shaped seeds are used for making leis and are enjoyed by hungry rats and beetles.



***Erythrina sandwicensis* seeds — CC**



***Erythrina sandwicensis* seed pods – Maui — HB**

Entire Range: Hawaiian endemic

Wild Habitat: Dry forest from sea level up to 600 m

Habit: Sparsely branching tree

Mature Height: 5–15 m

Stem/Trunk: The trunk has yellowish-orange bark, which is papery, with shallow fissures; the trunk and branches are sparsely armed

Leaves: The leaves are deciduous, pinnately trifoliate (leaflets in threes); leaves are obtuse to rounded with the terminal leaf almost triangular. Leaflets about 6 cm long by 7 cm wide. The leaflet upper surfaces are smooth, the undersides are tomentose (hairy); lateral leaf stalks about 5 mm long, the terminal leaf stalk about 15 cm long

Inflorescence/Flower: The flowers are papilionaceous (referring to a subfamily in the Fabaceae family named after the word root for "butterfly" because the flower resembles a butterfly and has an upper petal overlapping the others while in bud, two lateral wing petals, two keel petals, and ten stamens). The flowers are bilaterally symmetrical, perfect, and occur in terminal inflorescences. The corolla can vary from orange, yellow, white, to pale green

Fruit: The hanging pods are slightly woody and somewhat constricted between the seeds; they usually have one to three seeds per pod

Seed: The seeds are persistent, bean-like and are a showy red-orange to yellowish-orange, about 1.5 cm long by 1 cm wide, with a black hilum (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate from seed, first collect the pods when they are dry and brown. Remove the seeds by hand as soon as possible to avoid seed weevil damage.
- The seeds can be stored in a desiccation chamber, at room temperature, or in refrigeration for up to ten years.
- Scarify these large reddish seeds for fast germination.
- The seeds can be soaked in water for twenty-four hours with varied germination rates.
- Place the treated seeds flat in individual 4-inch pots or all together in 6–8-inch pots.
- Keep the seed mix on the dry side, especially for wiliwili from Kaho'olawe, which should be sown in 100 percent perlite. For the wiliwili from other origins, sow in a mix of 3 parts perlite to 1 part potting mix (3:1) with an additional inch of mix on top of the seeds.
- Keep them in a covered area to control the moisture and water them weekly.
- Move the seedlings into an area with partial sun as they germinate.



***Erythrina sandwicensis* seedlings – NTBG nursery — KLR**

GERMINATION (high germination rates)

- Germination can occur as soon as five days for pretreated seeds and up to a year for untreated seeds. Once they germinate, transplant them into tall 5-inch or taproot pots using a well-draining mix, poor drainage and too much moisture in the media will rot the roots.
- If the trees become root-bound, it will cause unhealthy root growth. Try to avoid this by repotting in a timely manner, and outplanting also in a timely way.
- Keep newly potted seedlings in the shade for a week or so, and then move them into full sun to harden them off.
- Water them when it is dry; fertilize with a foliar feed every month for healthy growth.
- Repot them every three to five months into taller pots and add new media.

CUTTINGS

- Take tip cuttings in the morning hours.
- Reduce all of the lower foliage, leaving only two to three leaves of new foliage at the tip.
- Make a 45° angle cut at the base and depending on cutting size apply rooting powders Nos. 8, 16, or 30 at the base end.
- Use a mix made of 3 parts perlite to 1 part vermiculite or 1 part fine black cinder (3:1).
- It may take about two to three months for the roots to develop.
- Once the roots have formed, transplant your cuttings into a cindery, well-draining mix.

AIR LAYERING

- You can air layer the unwanted branches that you would normally throw away. Use lengths of 2–5 feet long, and ½ –1 inch in diameter.
- Follow the directions for air layering and use rooting powders Nos. 16, 30, or 45 which all work well.
- The air layers will usually root in two to four months. Once they do, remove them from the tree and reduce their foliage by half. Pot up the air layers in tall, 1–3-gallon pots depending on size of the air layer.
- Use a well-draining soil mix so that the roots grow easily into the mix.
- Keep them in the shade and out of the wind for one month, then move them into an area with more sun, water only when dry, to keep roots from rotting.

OUTPLANTING

- The wiliwili will be ready for outplanting when the tree has outgrown a 1-gallon pot in about three to six months. It is a very fast-growing plant.
- When preparing to outplant choose a dry location in full sun with well-draining soil, and amend the soil as recommended.
- Water in the plants at first, then only water during times of prolonged drought. Do not water when the tree has lost its leaves; this is normal.
- Fertilize your trees with 8-8-8 or 10-10-10 NPK Fertilizer every six months or foliar feed monthly for faster growth.

PESTS

- Red spider mites can infest the wiliwili by occurring on the leaves, and ants may farm insects at the base of the plant. In each of these cases, control as directed.
- Mealybugs can infest the roots and stems. Use horticultural oils to control them.
- Powdery mildew can infest the leaves, especially if there is too much moisture. To manage this, first remove the affected leaves then reduce the frequency of watering.

FABACEAE

(LEGUME OR PEA FAMILY)

F

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Kanaloa	**Kanaloa**	*K. kahoolawensis*	E	end (Ka)



***Kanaloa kahoolawensis* seed pods – Kaho'olawe — KRW**

Full Sun

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds

GENERAL DESCRIPTION

Kanaloa is a new endemic genus that was recently discovered by NTBG's field collectors in 1994 on a little islet off of Kaho'olawe. Originally, there were only two known plants in the wild; since then, that number has been reduced to one from a single severe drought year, even though extensive watering regimes were carried out via helicopter. Propagation and conservation efforts are under way to increasing plant populations by protecting the last wild Kanaloa with fencing and monitoring it regularly for introduced animal and or insect damage.

The pollen of *Kanaloa* had been found in many soil core samples throughout the years by archeological studies, but botanists thought that the plant that belonged to the pollen was an early extinction because no one had ever described it or recorded its existence. Their findings also indicated that Kanaloa had been widespread and relatively common throughout Hawai'i (Olson and James 1982; Athens and Ward 1993; Burney et al. 2001; Rauzon 2001; Athens et al. 2002). When these two large, prostrate shrubs were located, the collectors knew they had something new. Plant material was sent to a Fabaceae expert where it was determined that it was a new genus within the Fabaceae family.

Entire Range: Hawaiian endemic
Wild Habitat: Dry, coastal areas
Habit: Dioecious, spreading shrub
Mature Height: 1 m

Stem/Trunk: Woody, bran-ching, brown to gray with fissures

Leaves: The leaves resemble those of *Bauhinia*, with bilobed leaves (two equal lobes) split about a third of the way down the leaf; new growth is pale red-dish-green, mature leaves are pale green with veins somewhat prominent, especially on the underside. The leaf stalks are short.



Kanaloa kahoolawensis **two-week-old seedling – NTBG nursery — DR**

Inflorescence/Flower: A small, pale whitish powder-puff-like flower resembling those of *Leucaena*, about 5 mm in diameter; dioecious

Fruit: Brownish pods with one seed each, about 3 cm long by 2.5 cm wide

Seed: Seeds are dark brown, flat, black, heart-shaped and about 6 mm in diameter (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

I received cutting material many times and conducted experiments with different rooting powders, potting mixes, and various site locations in the irrigation system. These all failed and no rooting resulted. The cuttings would flush out new foliage and even bloom, which I removed, because when an unrooted cutting produces flowers, the flowers are using up the stored food needed to produce roots. However, in a couple of months they would all die after using up their stored food supply in the stems. It was a very frustrating situation for me and the collectors. We all wanted to propagate, save, and increase this endangered plant. Then I received one flat, black, heart-shaped seed that was very plump and healthy-looking, not thin and shriveled. Because it was a Fabaceae seed, I knew that scarification was the best treatment for quick germination.



Kanaloa kahoolawensis **3 year old plant in planter – NTBG nursery — KLR**

The seed germinated in thirty-six hours (the quickest sprouting native seed I've ever grown). In one week's time, the seedling grew so fast that it had to be repotted into a 1-gallon pot; then the plant's growth slowed down and not until seven months later did I have to repot it into a 2-gallon pot with well-draining soil. The Kanaloa now is planted in a large planter box with cindery well-draining soil, it is kept close to the nursery for daily monitoring for flowering, possible seeds, and hungry insects. Nutritional and soil analysis were conducted on the cultivated plant in cooperation with the University of Hawai'i Agricultural Diagnostic Service Center (ADSC) to help understand its requirements. The Chinese rose beetle and ants seem to be the worst pests.

To date, (2000) *Kanaloa* at the NTBG nursery have flowered several times, and attempts were made to pollinate the flowers with no success. Air layering, grafting, and cuttings have all been unsuccessfully attempted. So far, using viable seeds is the only known way to propagate *Kanaloa*. This is yet another example of a weakened genus, resulting from a small, inbreeding, bottlenecked population.

FABACEAE

(LEGUME OR PEA FAMILY)

F

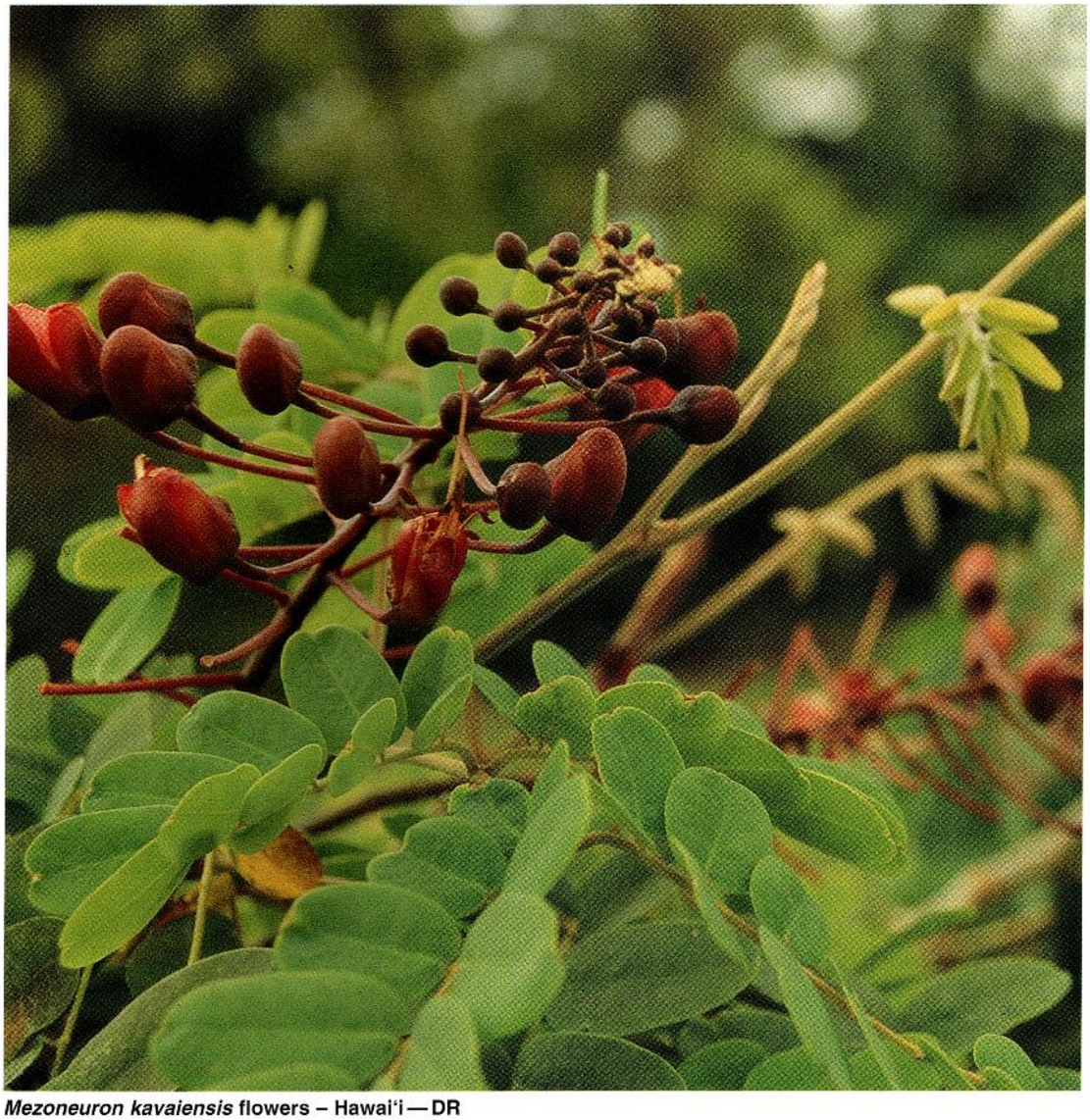
GENUS:

Mezoneuron (synonym: *Caesalpinia*)

HAWAIIAN NAMES:

Uhiuhi; kāwa'u; kea

SPECIES	STATUS	HAWAIIAN RANGE
M. kavaiensis	E	end (K, O, M, H) dry to mesic forest



***Mezoneuron kavaiensis* flowers – Hawai'i — DR**

Full Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds and air layering

GENERAL DESCRIPTION

The endangered uhiuhi grows in dry to mesic forests as large shrubs or small trees 30 feet tall with dark gray bark. The compound leaves are made up of about ten oppositely paired small, bright-green leaflets. Attractive pinkish-red flowers are loosely clustered at the branch ends on long, thin, spiked flower stalks, 3–6 inches long. These mature into flattened, winged, brown pods that contain one to four light brown seeds resembling brown lima beans. It is believed that the seeds of the uhiuhi ancestor originally floated to the Hawaiian Islands but they have since lost their ability to float, and this has contributed to their loss of dispersibility, a trend with many island species (Carlquist 1980; Grant 1998).

The black twig borer lays its eggs into the twigs and branches. The larvae feed off the pith, and cause thick black sap to exude from the wounds. The affected branches usually die back and need to be removed and discarded.

This species is easily air layered. Use high rooting powders such as Nos. 30 and 45. Uhiuhi are so threatened in the wild (only one or two trees left in some populations) that even unwanted branches should not go to waste. Use this opportunity to air layer them instead. I have tried many times unsuccessfully to root cuttings with different rooting powder strengths. Instead of rooting, they rotted.

Entire Range: Hawaiian endemic

Wild Habitat: Dry to mesic forests

Habit: Unarmed shrubs or trees

Mature Height: 4–10 m

Stem/Trunk: Bark is dark gray, thick, rough, and checked into rectangular or oblong plates

Leaves: Leaves bipinnately compound, leaflets subopposite, each leaf oblong, about 3 cm long by about 2 cm wide, with a rusty tomentose (hairy) midrib on the lower surface.

Inflorescence/Flower: Flowers are caesalpinaceous (having characteristics of a pea flower, bilaterally symmetrical, the upper petal overlapped by the others in bud, all petals spreading at anthesis) perfect, corolla rose colored, about 20 mm in diameter, stamens exerted, with the filaments reddish pubescent in lower part, anthers red and occurring in terminal racemes

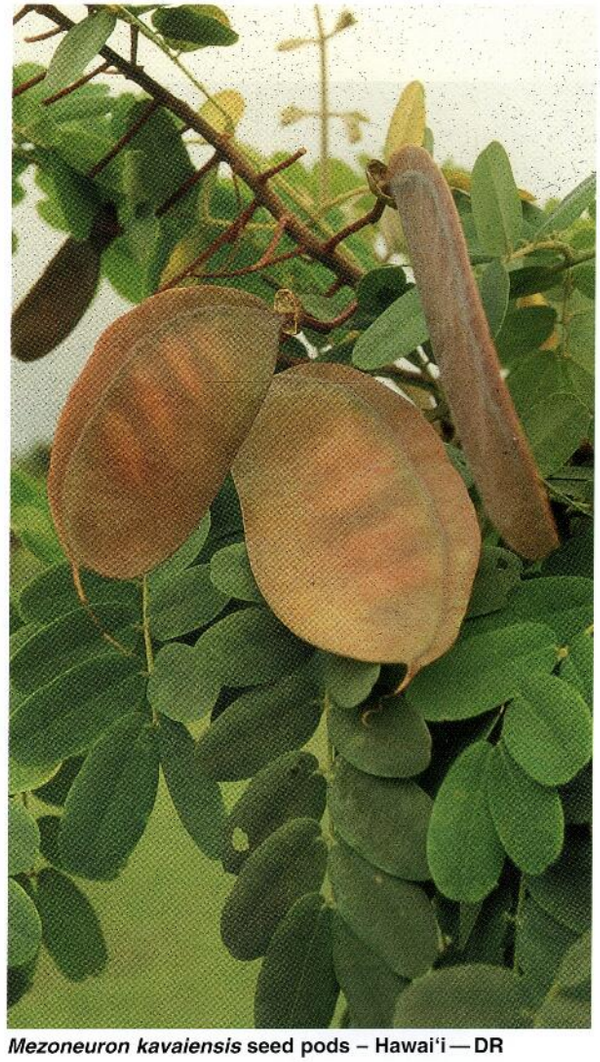
Fruit: The fruit is a seedpod with a longitudinal wing near the upper margin, smooth with two to four seeds arranged transversely

Seed: The seeds are pale brown, ovoid, and flattened about 2 cm long by 1.5 cm wide (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- Germination of the seeds is the same procedure as described for the *Acacia*. Scarification works best.
- When scarifying the seed, make the nick in the seed coat at the top of the seed, about ¼ inch from the hilum (the oval scar where the seed was attached to the pod during development).
- When planting the seeds, lay them flat on the leveled seed mix made up of 3 parts perlite to 1 part potting mix (3:1).



***Mezoneuron kavaiensis* seed pods – Hawai'i — DR**

GERMINATION (high germination rates)

- The seeds may germinate in five days if they are scarified; it may take up to two months if the seeds are only soaked.
- Carefully transplant the seedlings into 5-inch tall pots when two to four true leaves develop. Be careful not to damage the thin, brittle, sensitive roots.
- Use a well-draining cindery soil mix, and keep them in the shade.
- *Acacia* is faster-growing than *Uhiuhi*, a good indicator for repotting is when the plant is twice as tall as its pot.



***Mezoneuron kavaiensis* seedlings – NTBG nursery — KLR**

- To avoid root damage do not ever allow the trees to become root-bound in the pots.
- Move them into full sun to harden them off for outplanting.

AIR LAYERING

- You can air layer the unwanted branches that you would normally throw away. Use lengths of 2–5 feet long, and ½ –1 inch in diameter.
- Follow the directions for air layering and use rooting powders Nos. 16, 30, or 45 which all work well.
- The air layers will usually root in two to four months. Once they do, remove them from the tree and reduce their foliage by half. Pot up the air layers in tall, 1–3-gallon pots depending on size of the air layer.
- Use a well-draining soil mix so that the roots grow easily into the mix.
- Keep them in the shade and out of the wind for one month, then move them into an area with full to partial sun to harden them off for outplanting.

OUTPLANTING

- Uhiuhi trees will be ready for outplanting in six months to a year, when they are twice as tall as their 1-gallon pot.
- Choose a site in full to partial sun, out of direct strong wind; provide some support for the young trees until they become established and stable.
- Plant with other plants, shrubs, ferns and small trees for added protection.
- Amend the planting hole as recommended for soil to be well-draining, and fertilize with a small amount of 8-8-8 or 10-10-10 NPK.
- If the plants have become root-bound, gently loosen the circling roots to avoid unhealthy growth. Try to straighten the root out into the planting hole.
- Water them weekly until they become established, then water only in times of prolonged drought.
- Prune off the branches that die back from the twig borer.
- A pretty tree with its rose-colored flowers and easy to take care of, small and noninvasive.

PESTS

- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches.
- Red spider mites can infest the uhiuhi on the undersides of leaves. Control them with horticultural oils as described.
- Ants may infest the uhiuhi and farm insects on the plant; control them as directed.
- Scales can infest the trunk and stems of uhiuhi (usually associated with ants); apply horticultural oils as recommended to control them.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:
Mucuna

HAWAIIAN NAMES:
Kā'e'e; kā'e'e'e

COMMON NAME:
Sea bean

SPECIES	STATUS	HAWAIIAN RANGE
M. gigantea spp. *gigantea*	—	ind (K, O, Mo, M, H)
M. sloanei var. *persericea*	E	end (M)
M. sloanei var. *sloanei*		ind (K, O, M, H)

Full Sun–Partial Sun

Range
Endemic and Indigenous[1]

Description
climbing, woody vine

Propagation
seeds

1: Range differs for each species.



***Mucuna gigantea* flowers—F&KS**

GENERAL DESCRIPTION

The sea bean is a large, climbing, woody vine in Hawai'i, found sprawling over rocks and other plants along the ocean and coastal streams. The foliage is dark green, with three broad ovate leaflets and unusual greenish-yellow flowers that hang down on long, rope-like stalks. The pods are covered with irritating stiff orange-brown hairs; be careful to protect your hands when collecting. The ripe brown pods contain attractive, flat, mottled, brown seeds: two to four per pod. In Hawai'i the seeds are polished and made into attractive leis and are also used in a powdered form as a strong cathartic (Neal 1965). These seeds are well adapted for water dispersal, drifted to these islands by strong ocean currents.

Entire Range: Hawaiian endemic (*M. sloanei* var. *persericea*) to EM; indigenous (*M. gigantean*) widespread from East Africa, India, China, Malaysia, and the Pacific islands to the Societies and Hawai'i (K, O, Mo, M, H, La, Li)

Wild Habitat: Occurs on beaches and along coastal streams

Habit: Large, woody, pubescent liana (woody vine), branching, climbing, or sprawling

Mature Height: 8–80 m long

Stem/Trunk: Woody stems

Leaves: Leaves pinnately trifoliate (in threes), leaflets broadly elliptic to ovate, about 9 cm long by 5 cm wide, lateral leaflets asymmetrical

Inflorescence/Flower: Flower is pea-like, corolla color various, yellowish-green to white and pale lilac; stiff, stinging hairs on calyx

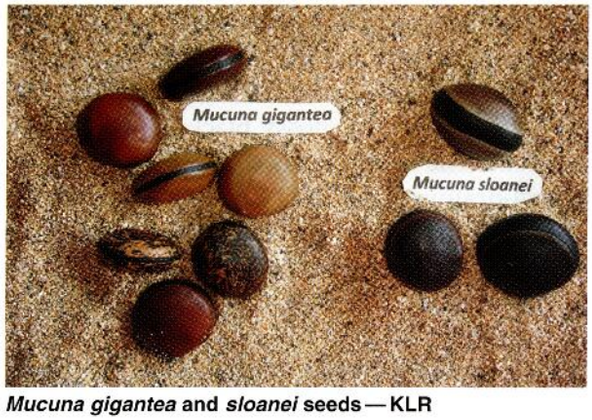
Fruit: The pods are compressed and about 15 cm long by 5 cm wide, and have stiff, irritating, orange-brown hairs on the pods

Seed: Seeds are two to four per pod, brown, mottled brown and black, or sometimes entirely black, discoid, about 3 cm long by 2 cm wide; the hilum extends five-sixths of the way around the circumference (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the pods when they are dry and brown. Watch for the irritating tiny hairs on the pods. Use gloves.
- Remove the seeds as soon as possible to prevent any damage from seed weevils. It is common for seed weevils to bore into the pods and feed on the seed embryos.
- Cleaned seeds can be kept dry in the refrigerator for a few years.
- To sow the large round seeds, soak them for one hour to soften the hard seed coats, and then scarify. Or soak the seeds in tap water for twenty-four hours.
- Do not scarify the seeds and then soak them in water, or you will drown and kill the embryo if they are soaked longer than just a few minutes.
- Plant the seeds in tall, individual 3- to 4-inch pots or together in 6- to 8-inch pots.



***Mucuna gigantea* and *sloanei* seeds—KLR**

- Place the seeds flat onto a mix of 3 parts perlite to 1 part potting mix (3:1), 1 inch apart, then cover the seeds with ½ inch of additional mix.
- Water the seeds in, then water every other day to every two days. Do not keep the mix soaking wet, because the seeds will rot.
- Keep the pots in a covered area to protect them from heavy rains.

GERMINATION

- If scarified all viable seeds will sprout in about five days. If the seeds are only soaked, germination can vary and take months.
- Transplant them individually into 5- to 6-inch pots, using well-draining cindery soil.
- These are fast-growing vines that require repotting every three to six months into larger pots with additional new soil.
- Move the vines into an area with full to partial sun to harden them off for outplanting.

OUTPLANTING

- These vines will be ready for outplanting in three to six months, when the plants have outgrown a pot between 6 inches and 1 gallon in size.
- Outplant in the full sun with amended well-draining soil; they grow naturally on beaches or along streams.
- Kā'e'e is a fast-growing vine that will take over what it is growing on in a few months.
- Choose a site where the vine can grow over or up a tree, fence, or trellis. The showy yellowish-green flowers will hang down from the vine.
- Water the vines in and then water weekly if the weather is dry.

PESTS

- Pests can include red spider mites, which take up residence on the underside of the leaflets. To control them spray with horticultural oil.
- To help prevent seed weevil damage treat the soil around the plant with a systemic pesticide before the plants bloom. Or collect the seeds and clean them in a timely manner to prevent extensive damage.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:

Senna

HAWAIIAN NAMES:

Kolomona; heuhiuhi; kalamona; uhiuhi

SPECIES	STATUS	HAWAIIAN RANGE
S. gaudichaudii	—	ind (HI exc. Ni) dry coastal to low mesic forest

Full Sun

Range
Indigenous

Description
shrub to tree

Propagation
seeds



***Senna gaudichaudii* seed pods – Kaho'olawe — KRW**

GENERAL DESCRIPTION

In Hawai'i, kolomona grows as subshrubs to small trees, occurring in coastal sites to low mesic forests. The round, compound leaves are paired into three to five leaflets, 1 inch long. Eight to ten small greenish to yellow-white flowers cluster at branch ends. The thin, flat, dark, seed pods are 2–4 inches long, containing five or so flat glossy black seeds; healthy plants are very prolific, producing numerous seeds. The kolomona is a slow-growing, low-maintenance shrub if planted in full sun and well-draining soil. Plant it with its relatives for example, wiliwili, mamane, or koai'a trees, along with one of the vines and create a Fabaceae garden. They are all easy to germinate and require little maintenance.

Entire Range: Indigenous to the Pacific Basin, the New Hebrides, Austral Islands, Rapa, Henderson Island, Fiji, Hawai'i, and maybe New Caledonia

Wild Habitat: Coastal shrubland, disturbed Hala forests, dry forests, occasionally mesic forests, 9–920 m elevation

Habit: Shrub

Mature Height: 0.5–4 m

Stem/Trunk: Sparingly branching, newer growth sparsely to densely pubescent (hairs spreading)

Leaves: Leaves are deciduous, pinnately compound and the leaflets opposite, with four to five pairs per leaf; the leaflets are oblanceolate to elliptic about 5 cm long by 1 cm wide, with the upper surface green, smooth, and with pubescence along the midrib; the lower surface pubescent (hairy) only along the midrib. Nectaries are present usually between the first and second leaflets

Inflorescence/Flower: The flowers are in racemes, 2–10 cm long, with the flower stalks 11–24 mm long; the petals are greenish to chartreuse or pale yellow, 9–17 mm long; ten fertile stamens, all similar to one another

Fruit: Pendulous pods, papery, compressed, 6–13 cm long, 1–1.5 cm wide. The base is constricted to a short stipe, and the pod is indehiscent or reluctantly so.

Seed: The seeds are dark reddish-brown, glossy, arranged transversely in one row, 6–8 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate from seed, first collect the pods when they are brown and papery. Keep them in a paper bag until they are cleaned.
- Remove the seeds from pods by hand. The seeds can be stored in desiccation, at room temperature, or in refrigeration for up to ten years.
- Scarify the seeds for fast germination. For large numbers of seeds, soak them in tap water for twenty-four hours.
- Sow the seeds in a shallow flat of leveled media made up of 3 parts perlite to 1 part potting mix and then add ½ inch of additional mix on top.
- Keep the flat in a covered area, water every couple of days and do not let the mix dry out completely.



***Senna gaudichaudii* seedlings – NTBG nursery — KLR**

GERMINATION

- Germination may occur in one week for the scarified seeds, and between one week and three months for all of the viable soaked seeds to sprout.
- Once they have germinated, transplant them into 4-inch pots when four to six true leaves develop. Use well-draining mix.
- Keep them in the shade and water them weekly; move them into more sun after two weeks to harden them off.

OUTPLANTING



***Senna gaudichaudii* flowers – NTBG nursery — DR**

- A good indicator to outplant is when the plants have outgrown a 4-inch or 1-gallon pot; this should be after about four to six months.
- Choose a site with full sun and well-draining soils and amend as directed.
- Fertilize your kolomona every six months or foliar feed monthly.

PESTS

- Pests of *Senna* include ants, which take up residence at the base of the plants and will farm scales, root mealybugs, and aphids, weakening the plant; control them as recommended.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Sesbania	**'Ohai**	*S. tomentosa*	E	end (HI) dry lower habitats

Full Sun

Range
Hawaiian Endemic

Description
sprawling prostrate shrub or small tree

Propagation
seeds



***Sesbania tomentosa* flowers – O'ahu — SP**

GENERAL DESCRIPTION

'Ohai grows in many variable forms from a small tree in higher elevations to a sprawling prostrate shrub in lower coastal environments. An earlier treatment recognized seven taxa endemic to Hawai'i (Char 1983). The small leaflets are short and narrow, sometimes covered with fine silvery hairs, a characteristic of the beach 'ohai that need to protect themselves from the harsh sun and salt spray. The 'ohai flowers come in many different colors, from yellow or orange to reddish, depending on the location and island. Long, narrow, green pods form after flowering, with about ten small olive-green to blackish-brown seeds inside. The seeds are often eaten by seed weevils. 'Ohai is a beautiful plant if planted correctly in the landscape along with a wiliwili or a mamane tree. 'Ohai are very susceptible to root-knot nematodes in the surrounding soil. To control the nematodes treat the soil with a nematocide following the manufacturer's instructions.

Entire Range: Hawaiian endemic

Wild Habitat: Lower elevation dry habitats, sandy coastal areas, dunes, soil pockets on lava, and along pond margins, 0–830 m elevation

Habit: Shrubs with decumbent or sprawling branches to small, erect trees

Mature Height: 14 m long; or 6–22.5 m tall

Stem/Trunk: Branches densely silky, villous (hairy), or less hairy, woody

Leaves: The leaves are pinnately compound, with numerous leaflets (from twelve to thirty-eight), oblong-elliptic to narrowly elliptic, densely to sparsely silky, and sometimes without hairs

Inflorescence/Flower: Flowers are papilionaceous (referring to a subfamily in the Fabaceae, named after the word root for "butterfly" because the flower resembles a butterfly and has

an upper petal overlapping the others while in bud, two lateral wing petals, two keel petals, and ten stamens). The flowers are bilaterally symmetrical, and perfect. Flowers, two to nine, in racemes, with a green calyx, the corolla variable from salmon-yellow, orangish-red, or scarlet, to (rarely) pure yellow

Fruit: The pods are variable and linear from 70–230 mm long by 4–6 mm wide; slightly flattened, constricted between the seeds, and indehiscent

Seed: The seeds are olive to pale or dark brown, oblong-ellipsoid to oblong about 5 mm long by 3 mm wide (Wagner et al. 1990)

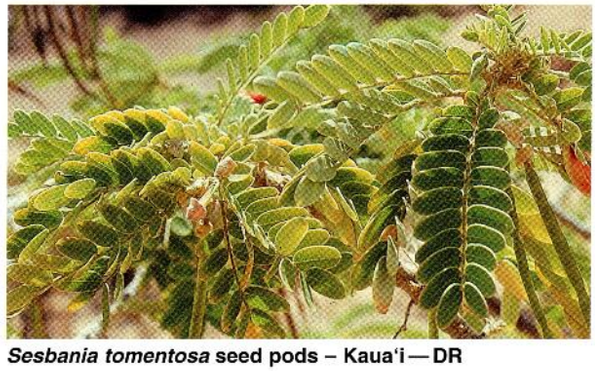
PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate from seed, first collect the mature pods brown in color. Keep seeds dry in a paper bag until cleaned.
- To clean, separate the seeds from the pods by hand, or use clippers to break the pods open.
- Seeds can be stored in desiccation, refrigeration, or at room temperature for ten or more years.
- Scarify the seeds for fast germination, or soak in hand-hot or tap water for twenty-four hours.
- Plant them in a shallow flat of mix made of 3 parts perlite to 1 part potting mix (3:1) then sprinkle ¼ inch of additional mix on top of the seeds.
- Water them in, then water weekly and keep the flat in a covered area.

GERMINATION

- All viable seeds will sprout in a week if they are scarified first. It will take two weeks to six months if they are soaked first.



***Sesbania tomentosa* seed pods – Kaua'i — DR**

- Make sure that the mix is well-draining. The beach species rot easily if they are kept too wet.
- After they germinate, transplant them into 4-inch pots and keep them in the shade for a week before moving them into full sun.

OUTPLANTING



***Sesbania tomentosa* flowers in 4-inch pot – NTBG nursery — DR**

- Your seedlings will be ready for outplanting in three to six months, or when they have outgrown a 4-inch pot for low shrubs, or a 1-gallon pot for small trees.
- Plant them in full sun with very well-draining soil, amended, as directed.
- Fertilize them every six months or foliar feed monthly for healthy growth.

PESTS



***Sesbania tomentosa* with aphids — DR**

- Pests include ants and red spider mites; control these as recommended.
- Root-knot nematodes can attack the roots; amend the surrounding soil as directed with nematocide.
- Seed weevils can attach the seeds of *Sesbania* by eating them. Clean the seeds as soon as possible to avoid further damage.
- Black twig borers lay their eggs into the stem of the young plants, and then the larvae eat the pith, killing or damaging the young plants. If you discover black twig borers in your 'ohai, cut off and remove all of the affected parts, and what remains of the plant will sometimes grow back, depending on the age of the plant. Also apply a systemic pesticide and follow the directions on the label.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:	HAWAIIAN NAMES:	SPECIES	STATUS	HAWAIIAN RANGE
Sophora	**Māmane; mamani**	*S. chrysophylla*	—	end (HI exc. Ni, Ka) dry shrubland to mesic forest



***Sophora chrysophylla* flowers – Moloka'i — KRW**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds

GENERAL DESCRIPTION

Māmane grows into small shrubs or trees up to 45 feet tall depending on the island and habitat. The colorful, golden-yellow, pea-like flowers develop on drooping twigs, turning the whole tree yellow when it is in full bloom. The 3- to 5-inch-long brown seed pods are ridged along the edges and contain small, rounded, bright yellow to orangish seeds. The Hawaiians used the very dense and hard wood for ʻōʻō (Hawaiian digging tools), timber, sled runners, and spades, and the bright seeds were used in lei's (Abbott 1992). The black or coffee twig borers and poor soil drainage are their worst enemies.

Entire Range: Hawaiian endemic

Wild Habitat: Dry forest, shrubland, mesic or wet forests, and subalpine, 450–3,240 m elevation range

Habit: Shrubs or trees

Mature Height: 15 m

Stem/Trunk: Woody branches longitudinally ridged, golden brown, strigose (with hairs), becoming smooth (without hairs) with age

Leaves: Leaves are pinnately compound, with leaflets (twelve to twenty) either alternate or opposite per individual plant. The leaflets are variable and usually oblong-ovate measuring 0.6 cm long by 1.5 cm wide, with the upper surface smooth or with a few hairs, the lower surface with some golden brown hairs. The leaflets have short leaflet stalks about 1–2 mm long; the leaf stalks are about 2 cm long.

Inflorescence/Flower: The flowers are papilionaceous (referring to a subfamily in the Fabaceae named after the word root for "butterfly" because the flower resembles a but-

terfly and has an upper petal overlapping the others while in bud, two lateral wing petals, two keel petals, and ten stamens). The flowers are perfect and bilaterally symmetrical. The pea-like flowers are in terminal axillary racemes; the corolla is bright yellow and the flower about 2.5 cm long by 1.25 cm wide

Fruit: The pods of *Sophora* are necklace-like in that they are constricted between each of the one to six seeds; the pods are about 12 cm long by 1 cm wide, have "wings" running longitudinally, and can be sparsely to densely covered with hairs

Seed: Seeds are yellow to grayish-black, ellipsoid to subglobose, and somewhat compressed, about 6 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEED (easy)

- To propagate from seed, first collect the pods when they are brittle and brown. Keep them dry in a paper bag prior to cleaning.
- To clean the seeds, remove the small yellow seeds from the pods; hand clippers may be helpful with this.
- The seeds can tolerate storage in the refrigerator or in desiccation for up to (or over) ten years if kept dry.
- Scarify each of the seeds, or for large numbers, soak them in hand-hot water or tap water for twenty-four hours.
- Plant them in a shallow flat with a mix made of 3 parts perlite or black cinder to 1 part potting mix (3:1) then sprinkle ¼ inch of additional mix on top of the seeds.
- Water them in, then water weekly and keep the flat in a covered area.

GERMINATION

- It may take from two weeks to up to six months for all of the viable soaked seeds to sprout.
- After at least four to six true leaves develop, transplant them into 4-inch pots. Māmane is more sensitive to handling than wiliwili or koa.
- Use a well-draining mix or the seedlings will die.
- Keep the seedlings in a shaded area for two weeks; then move them into an area with more sun to harden them off.
- Repot the seedlings about every six months into taller pots with new media.
- Root suckers with shoots will root if they are collected in the morning hours and are not allowed to dry out at any time. However, it is still best to grow them from seeds because the resulting tree roots are stronger.



***Sophora chrysophylla* seeding – NTBG nursery — DR**

OUTPLANTING

- Sophora may be ready for planting out within one year, or when it has outgrown a 1–2-gallon pot. The Māmane is slower growing than wiliwili and koa and require more care.
- Choose a site in partial to full sun in well-draining soil; amend the soil as directed.
- Water them in, then water weekly depending on the amount of rainfall, until there is new foliage growth.
- Once the māmane is well established, it requires very little maintenance.
- Fertilize every six months.

PESTS

- Pests can include red spider mites, which occur on the underside of the leaves. To control them, wash them off with a water hose or spray them with horticultural oil.
- Ants can also infest mamane. They take up residence at the base of the plant and will farm scales, root mealybugs, and aphids, weakening the plant; control them as recommended.
- Infestations from the black twig borer can attack the seedlings while they are still in the pots. Remove the affected branches and apply a systemic pesticide to control them.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:

Strongylodon

HAWAIIAN NAMES:

Nuku ʻiʻiwi; kā ʻiʻiwi; nuku

SPECIES	STATUS	HAWAIIAN RANGE
S. ruber	R	end (HI exc. L, Ni, Ka) mesic to wet forest

Partial Shade

Range
Hawaiian Endemic

Description
woody vine

Propagation
seeds



***Strongylodon ruber* habitat — JO**

GENERAL DESCRIPTION

Strongylodon is a rare climbing liana (woody vine), which often hangs from trees in mesic to wet forests. The hairless (three parted) leaflets are thin, flexible, and broadly ovate. Bright scarlet flowers 1 inch long hang from loose narrow clusters. The hard to find, wide flattened pods are smooth with long pointed tips and contain one to three black rounded seeds. These seeds once arrived in Hawai'i by floating in the ocean, since then the plants have evolved and the seeds have enlarged in size and lost their ability to float (Carlquist 1980). *Strongylodon* is a gorgeous vine that enhances the landscape if properly planted and maintained. A strong koa tree is a good branching tree for the *Strongylodon* to grow on.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic to wet forests from 180–825 m elevation

Habit: Branching liana (woody vine)

Mature Height: Not applicable

Stem/Trunk: Liana (woody vine) that is glabrous (without hairs or glands), and has herbaceous branches

Leaves: The leaves are pinnately trifoliate, papery when dry, both surfaces smooth, and with conspicuous small stipules. Each leaflet is broadly ovate to ovate about 10 cm long by 7 cm wide, and triple nerves along with many pairs of lateral veins



***Strongylodon ruber* flowers — SP**

Inflorescence/Flower: The flowers are papilionaceous (referring to a subfamily in the Fabaceae named after the word root for "butterfly" because the flower resembles a butterfly and has an upper petal overlapping the others while in bud, two lateral wing petals, two keel petals, and ten stamens). The flowers are perfect and bilaterally symmetrical. The brilliant scarlet pea-like flowers hang in clusters of two to three flowers per cluster, in pendulous false-racemes up to 45 cm long

Fruit: Pods are oblong-ellipsoid about 10 cm long by 5 cm wide; often curved like an "s," with strongly veined valves, and with one to three seeds

Seed: The seeds are black, subglobose (rounded), compressed. The hilum encircles the seed for one-third to one-half of its circumference (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate from seed, first collect the pods when they are mature and brown. Then remove the seeds from the pods.
- Scarify the seeds for fast germination. Follow the same protocol for sowing the seeds as for *Canavalia* (p. 172) and *Mucuna* (p. 182).
- The cleaned, dry seeds can also tolerate storage in the refrigerator for up to ten years.
- Care and maintenance for *Strogylodon* is similar to *Canavalia* and *Mucuna*, with the exception that it is necessary to keep *Strongylodon* in partial shade because they are from a wetter environment.

GERMINATION

- The scarified viable seeds will sprout in about five days. If the seeds are only soaked, germination can vary and take months to germinate.
- Transplant them into 5- or 6-inch pots, using well-draining cindery soil.
- These fast-growing vines require repotting every three to six months into larger pots with additional new soil with small amounts of 8-8-8 NPK fertilizer added.
- Move the vines into an area with partial sun to harden them off for outplanting; foliar feeding them monthly.

OUTPLANTING

- Your *Strongylodon* will be ready for outplanting in about six months or when it has outgrown a 1-gallon pot.
- Choose a protected site in partial shade with well-draining soil.
- Also select a site with a tree, fence, or arbor to allow your vines to grow on, such as an older koa tree.
- Water them weekly, and then water in times of drought. Monitor your vine, especially at first, making sure it is healthy and vigorous where it has been planted. If it is not doing well, carefully move it to a better location.
- *Strongylodon* and *Vicia* are more sensitive and require more care to maintain after planting out than *Canavalia* and *Mucuna*. *Strongylodon* require more shade, moisture and "tender loving care."

PESTS

- Seed weevils will eat the seeds of *Strongylodon*. Before the plant blooms, apply a systemic pesticide to control weevils.
- Ants can also infest *Strongylodon*; they take up residence at the base of the plant and will farm scales, root mealybugs, and aphids, weakening the plant; control them as recommended.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:	COMMON NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Vicia	**Hawaiian vetch**	*V. menziesii*	E	end (H)

Partial Sun–Shade

Range
Hawaiian Endemic

Description
climbing, perennial herb

Propagation
seeds



***Vicia menziesii* habitat — SB**

GENERAL DESCRIPTION

Vicia was the first Hawaiian plant to be put on the endangered species list. It is only found in two populations on the Big Island. It is a climbing perennial herb occurring in wet to mesic forests growing up trees and shrubs. There are 8–12 narrow oblong leaflets that are slightly hairy. The colorful curved flowers (six to nine per raceme) are yellowish-white when they are young, then turn rose-purple with age. The flowers are very showy when hanging from the trees in the forest. The seed pods blacken with maturity and usually contain about six round black seeds. *Vicia* seeds have very inconsistent germination rates unlike the other genera in Fabaceae. I suspect that they have become casualties of the genetic bottlenecking of small nonviable inbreeding populations, which has weakened the Hawaiian genus.

Entire Range: Hawaiian endemic

Wild Habitat: Wet to mesic forests

Habit: Coarse, climbing, perennial herbs, supported by the branches within the canopy of trees or shrubs

Mature Height: 15–200 dm long



***Vicia menziesii* flowers — SB**

Stem/Trunk: Stems with tendrils; pubescent when young, and only sparsely so when mature

Leaves: Leaves are pinnately compound with eight to twelve leaflets, which are alternate or subopposite arranged; with stipules, the small leaflets are narrow, oblong-ovate about 55 mm long by 20 mm wide, sparsely pubescent (hairy), and they can have slightly dentate (teeth-like) margins

Inflorescence/Flower: The flowers are papilionaceous (referring to a subfamily in the Fabaceae named after the word root for "butterfly" because the flower resembles a butterfly; it has an upper petal overlapping the others while in bud, two lateral wing petals, two keel petals, and ten stamens). The flowers are perfect and occur in axillary racemes. There are six to nine flowers in the racemes. The corolla is about 30 mm long, yellowish-white when young and turning a rose-purple with age

Fruit: The pods are black at maturity, oblong-ellipsoid, about 95 mm long by 18 mm wide and stipulate

Seed: The seeds are black, globose (round), about 6–8 mm in diameter; the hilum encircles the seed about three-fourths of the circumference (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the pods when they are black and papery; keep them dry in a paper bag.
- Remove the small round black seeds from the pods by hand.
- Store these seeds using the same protocol as for *Acacia* (pg.167).
- Use the same recommendations for starting the seeds, caring for the seedlings, and outplanting them as *Strongylodon*.
- *Vicia* need a lot of care because of their weakened genetic condition.

F

FABACEAE

(LEGUME OR PEA FAMILY)

GENUS:
Vigna

HAWAIIAN NAMES:
Mōhihihi; nanea; pūhilihili

COMMON NAME:
Beach pea

SPECIES	STATUS	HAWAIIAN RANGE
V. adenantha		ind (O, H)
V. marina	—	ind (HI, exc. L, Ni, Ka) coastal to dry shrubland
V. o-wahuensis	E	end (HI exc. K) dry grass - shrubland

Full Sun

Range
Endemic or Indigenous[1]

Description
climbing, perennial herb

Propagation
seeds and cuttings

1: Range differs for each species.



***Vigna o-wahuensis* flowers and pods – Hawai'i — SP**

GENERAL DESCRIPTION

Vigna are slender, twisted, climbing, perennial herbs found in coastal habitats (*V. marina*) to dry grasslands (*V. o-wahuensis*) growing along the ground, up shrubs and trees. The three parted leaflets are diamond-shaped and hairy. Pea-shaped yellowish-green flowers form on spike-like racemes and hang from the plant. Long narrow seed pods contain up to fifteen small brownish-black seeds.

Entire Range: *V. o-wahuensis* is endemic to all of the main islands in Hawai'i except Kaua'i; *V. marina* is indigenous and pantropical, and also occurs on all of the main Hawaiian Islands

Wild Habitat: *V. o-wahuensis* occurs primarily in dry grassland and shrubland between 10–1,370 m elevation. *V. marina* is a coastal plant, occurring at the vegetation line on sandy beaches and rarely inland on sea cliffs and dry shrubby slopes, from sea level to 120 m

Habit: *V. o-wahuensis* is a slender, twining annual or perennial herb; *V. marina* is a succulent creeping or climbing perennial herb becoming woody at the base

Mature Height: 1–4 dm long (*V. o-wahuensis*); several m long (*V. marina*)

Stem/Trunk: Herbaceous twining stems, sparsely to densely hirsute (hairy); in *V. o-wahuensis* the stem can be woody at the base

Leaves: Leaves pinnately trifoliate with stipules. *V. o-wahuensis* has membranous leaflets, variable in shape from ovate to linear about 6 cm long by 2 cm wide, and sparsely covered with hairs. *V. marina* has elliptic to obovate leaflets about 7 cm long by 5 cm wide, and are initially sparsely covered with appressed hairs, which later become smooth

Inflorescence/Flower: The flowers are papilionaceous (referring to a subfamily in the Fabaceae named after the word root for "butterfly" because the flower resembles a butterfly and has an upper petal overlapping the others while in bud, two lateral wing petals, two keel petals, and ten stamens). The flowers are perfect and occur in axillary or terminal racemes. *V. o-wahuensis* has one to four flowers per raceme, with green calyx, about 6 mm long, and sparsely covered with hairs; the corolla is membranous, pale yellow or green-

ish-yellow, and about 23 mm long. *V. marina* has slightly waxy flowers in racemes that are about 10 cm long, a green calyx that is tinted reddish, the corolla is green while in bud but turns a bright yellow at anthesis and is about 15 mm long

Fruit: Linear pods that are either not inflated or only slightly inflated, about 65 mm long by 5 mm wide and sparsely hairy and only slightly constricted between seeds (*V. o-wahuensis*); pods that are linear-oblong, inflated, slightly curved, about 45 mm long by 8.5 mm wide, smooth and only slightly constricted between seeds (*V. marina*)

Seed: Small gray to black seeds, up to fifteen per pod, and angular-ellipsoid, about 5 mm long by 3.5 mm wide (*V. o-wahuensis*); seeds two to ten per pod, pale brown to reddish-brown, kidney-shaped to ellipsoid, about 6 mm long by 5 mm wide and slightly compressed (*V. marina*) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate mōhihihi from seed, first collect the pods when they are dry and brown. Remove the small grayish seeds as soon as possible to prevent any damage from seed weevils.
- The seeds can be stored dry at room temperature, or dry in a refrigerator for a few years, without losing viability.
- Soak the seeds in tap water for twenty-four hours to speed up germination, or scarify the small seeds.
- Do not scarify the seeds and then soak them in water as you will drown and kill the embryo if they are soaked longer than just a few minutes.
- Plant the seeds in tall, individual 2- to 3-inch pots or together in 6- to 8-inch pots.
- Place the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), then cover the seeds with ½ inch of additional potting mix.
- Water the seeds in, then water every other day to every two days. Do not keep the potting mix soaking wet because the seeds will rot.
- Keep the pots in a covered area to protect them from heavy rains.

GERMINATION

- If scarified all viable seeds will sprout in about five days. If the seeds are only soaked, germination can vary and take one to two months.
- Transplant them into 4-inch pots, using well-draining cindery (*V. o-wahuensis*) or sandy (*V. marina*) soil mix.
- These are fast-growing vines that require repotting every three to six months into larger pots with additional new well-draining soil.
- Move the vines into an area with full sun to harden them off for outplanting.

OUTPLANTING (fast growing)

- The mōhihihi vines will be ready for outplanting in three to six months, when they have outgrown a 6-inch pot.
- Choose an outplanting site that is in full sun in sandy (*V. marina*) or cindery (*V. o-wahuensis*) well-draining soil.
- Choose a site where the vine can grow along the ground with plenty of room to spread.
- Water the vines in and then water weekly if the weather is dry. Fertilize every six months or foliar feed monthly for more flowers.

CUTTINGS

Cuttings should be taken from the woodier portion of the vine. Remove the leaves and the green tips of the cuttings. Apply rooting powders Nos. 3–8. Use a cutting mix. This plant produces an abundance of seeds. I recommend seed propagation over cuttings for the vine species in this family.

Vigna can become weedy in the landscape. The production of so many seeds will result in "volunteers" germinating in the surrounding area. With this plant, you can pot up the unwanted seedlings and share them with friends, or plant out in other locations.

PESTS

- Ants at the base of the vine can cause the plant to weaken; control ants as recommended.
- To help prevent seed weevil damage treat the soil around the plant with a systemic pesticide before the plants bloom. Or, collect the seeds and clean them in a timely manner to prevent extensive damage.

F

FLACOURTIACEAE

(FLACOURTIA FAMILY)

GENUS:
Xylosma

HAWAIIAN NAMES:
Maua; a'e

SPECIES	STATUS	HAWAIIAN RANGE
X. crenatum	E	end (K)
X. hawaiiense	—	end (HI exc. Ni, Ka)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Xylosma hawaiiensis* seeds – Kaua'i — KRW**

GENERAL DESCRIPTION

Maua trees grow up to 30–45 feet tall and occur in mesic to wet forests. Early Hawaiians used the hard, dense wood for poi pounders. The threatened *X. crenatum* is found only on Kaua'i growing along streams and bordering swamps. These trees are dioecious, so having more individuals can increase the chances that male and female trees will exist within a population (and viable seed can be created). Their smooth, opposite leaves change in color from copper to dark-green with age. Small clusters of whitish, star-shaped flowers emerge from the leaf axils in early spring. *X. crenatum* has small, oblong, orange fruits when mature. Insect larvae often infest these rare seeds, rendering them nonviable. *X. hawaiiense* has rounded, reddish-purple berries containing one to two blackish seeds. I have successfully air layered the endangered *X. crenatum* in the wild by applying high rooting powder numbers on year-old woody growth.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic to dry and wet forests

Habit: Dioecious branching tree

Mature Height: 9–14 m

Stem/Trunk: Unarmed, dark gray bark, branches with elevated lenticels (*X. crenatum*), branches stiff

Leaves: Leaves alternate, more or less leathery, pinnately nerved, leaf margins with coarsely rounded teeth (*X. crenatum*) or glandular rounded teeth (*X. hawaiiense*) and with short leaf stalks. Leaves green and smooth on upper surface, and the *X. crenatum* has bronze leaves when young and the undersurface of the leaves are hairy

Inflorescence/Flower: Flowers are in short, axillary racemose cymes, each with small bracts. Four to eight sepals, the flowers lack petals, yet have a fleshy nectary disc. Male flowers

have numerous stamens that are exerted; female flowers lack stamens, have a superior ovary, one-celled parietal placentation, two to four placentas, few ovules on each placenta, two to four stigmas

Fruit: Fruit is a dry berry with a thin pericarp that is somewhat leathery

Seed: Seeds are few, obovoid, and with a thin aril (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate maua by seed, collect the berries when they are mature and the pulp is soft. Keep them moist in a plastic bag until they are cleaned.
- When you are ready to clean the seeds, separate the seeds from the pulp as directed for medium pulpy seeds.
- Once they are cleaned, start the seeds fresh for best results, or store dry in the refrigerator.
- Sow *X. hawaiiense* seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) and with ½ inch additional mix on top.
- Sow *X. crenatum* seeds onto moist sphagnum moss and keep them under a mist system that is only on during daylight hours (6 AM to 6 PM).
- Keep seed flats in a covered, shaded area, and water them every other day.

GERMINATION

- Germination takes about two to six months for all viable seeds to sprout.
- After the seeds have sprouted and produced at least three to four true leaves (in about two months), they will be ready to be transplanted into 3-inch pots.
- It is important to use a well-draining mix.



Xylosma crenatum **seedlings – NTBG nursery—DR**

- Repot every five to six months into larger pots, adding new media each time.
- Keep the plants in an area with partial sun and foliar feed them monthly.

AIR LAYERING

- Between March and May, air layering can be successful on the previous year's growth.
- Look for stems that are 1–2 inches in diameter and about 1–3 feet long.
- Apply rooting powder Nos. 16, 30, or 45 (they all work).
- Roots should develop in four to five months.
- Older growth that was two to three years old did root, but it took twice as long for the roots to develop (about eight months).

OUTPLANTING

- Your maua may be ready for planting out in about one year, when it has outgrown a 1–2-gallon pot.
- Choose a site for *X. crenatum* that is in a shady moist area with well-draining soil; amend the soil as recommended.
- Choose a site for *X. hawaiiense* that is in partial to full sun and has well-draining soil.
- Make sure that your maua is situated correctly when planting out by placing it at the same soil level as it was in the pot.
- Fertilize the seedlings with 8-8-8 or 10-10-10 NPK fertilizer every six months or foliar feed the plants monthly.
- Monitor your plants by regularly checking for insects or poor soil drainage.



Xylosma crenatum **new leaves – NTBG nursery—DR**

PESTS

- Control ants from the base for the tree and related pests as directed.
- In the wild, tiny insects lay their eggs into the seeds. The seed embryos are then eaten by their hatched larvae.

GENTIANACEAE

(GENTIAN FAMILY)

GENUS:

Schenkia (Syn: *Centaurium*)

HAWAIIAN NAME:

ʻĀwiwi

COMMON NAME:

Hawaiian erythraea

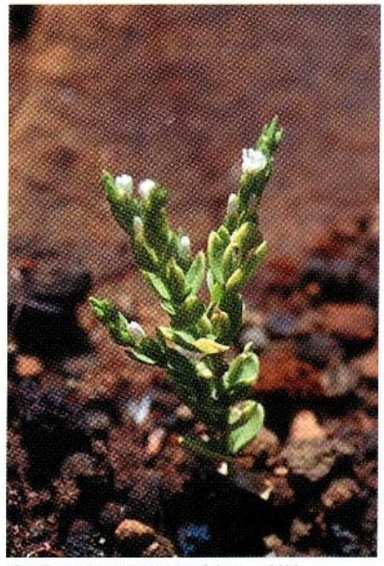
SPECIES	STATUS	HAWAIIAN RANGE
S. sebaeoides	E	end (K, O, Mo, M) dry coastal

Full Sun

Range
Hawaiian Endemic

Description
short-lived annual herb

Propagation
seeds



***Centaurium sebaeoides*—UK**



***Centaurium sebaeoides* flowers—GDC**

GENERAL DESCRIPTION

ʻĀwiwi is a small short-lived annual herb that occurs in dry, rocky, coastal areas on clay or volcanic soils. The upright stems are solitary or branched at the base, with fleshy, egg-shaped leaves that are closely arranged along the stem. Whitish to pale pink flowers form on spikes above the leaves, as do the rounded capsules that contain many tiny brown seeds. *Schenkia* is an easy plant to propagate and grow but is short-lived. This plant will regenerate itself if grown in the appropriate location.

Entire Range: Hawaiian endemic

Wild Habitat: Occurs in scattered remnant sites, and it is rare on volcanic or clay soil, in dry rocky, coastal sites

Habit: Erect, glabrous annual herb

Mature Height: 6–20 cm

Stem/Trunk: Solitary or branching stems, nearly always branched in the inflorescence

Leaves: Leaves are opposite, entire margins, fleshy, obovate to broadly elliptic, about 2 cm long by 1 cm wide

Inflorescence/Flower: Flowers occur in terminal, elongate spike-like cymes, with elliptic bracts; the calyx about 8 mm long. The corolla is white to a very pale pink.

Fruit: Fruit are cylindrical capsules about 9 mm long

Seed: The seeds are numerous, tiny, brown, and about 0.25 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, collect the dry capsules and keep them dry in a paper bag until it is time for cleaning.
- To clean them, separate the small brown seeds from capsules as directed for small dry seeds.
- Start the seeds when they are fresh; no seed treatment is necessary.
- Surface sow seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1); followed by watering in the seeds.
- Keep them in a covered area. When they start to germinate, provide them with more sun (although not full sun all day long).

GERMINATION

- Germination may take one to three months for all viable seeds to sprout.
- Once at least four true leaves develop, they are ready to be transplanted into 2-inch pots filled with well-draining cinder or sandy media. Follow the recommendations for well-draining mix.
- Keep them in the shade for two weeks, then move them into more sun.
- Repot them into 4-inch pots when they have outgrown the 2-inch pots.
- These plants are best grown from seeds. When they are grown from cuttings they are short-lived, and a dug-up, rooted plant will not last as long as a seedling.

OUTPLANTING

- *'Awiwi* will be ready for outplanting after it has outgrown a 2–4-inch pot.
- For best results, choose a site in full sun with well-draining soil.
- Amend the planting hole with cinder or sand following the recommendations.
- Plant *'awiwi* with other coastal plants such as niao, 'ilima, or hinahina.
- Water in the plants initially, and then water them in times of prolonged drought.
- If the conditions are favorable the 'āwiwi will regenerate itself.



S. sebaeoides **– Maui — F&KS**

- Foliar feed them once a month or use a small amount of 8-8-8 NPK fertilizer.

PESTS

- Slugs love to feed on herbaceous plants; control them with slug bait as recommended.
- Ants will farm scales, aphids, and mealybugs; control them with systemic pesticides or horticultural oils.

GERANIACEAE

(GERANIUM FAMILY)

GENUS:

Geranium

HAWAIIAN NAMES:

Nohoanu; hinahina

COMMON NAME:

Cranesbill

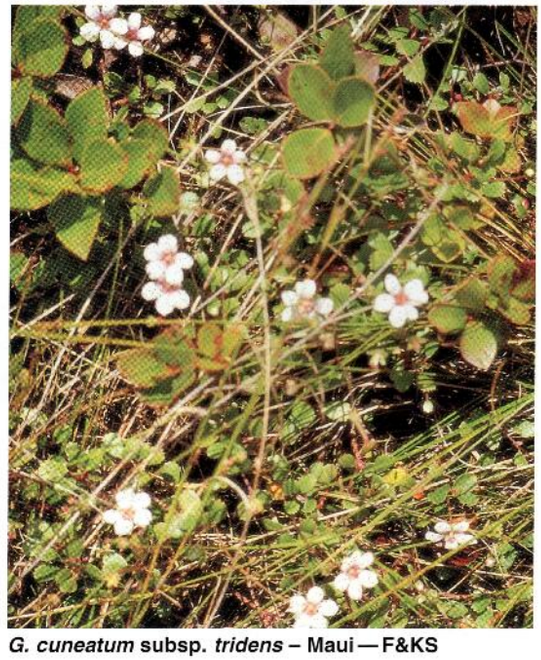
SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
G. arboreum	E	end (M) alpine
G. cuneatum spp. cunneatum	—	end (H)
G. cuneatum spp. hololeucum	—	end (H) alpine
G. cuneatum spp. hypoleucum	—	end (H)
G. cuneatum spp. tridens	—	end (M)
G. hanaense	V	end (M) bog
G. hillebrandii	R	end (M) Mt. 'Eke
G. kauaiense	R	end (K) bog
G. multiflorum	E	end (M) wet forest

Partial Sun

Range
Hawaiian Endemic

Description
small shrub

Propagation
seeds and cuttings



***G. cuneatum* subsp. *tridens* – Maui — F&KS**



***G. arboreum* – Maui — F&KS**

GENERAL DESCRIPTION

In Hawai'i the native geraniums grow as shrubs or subshrubs instead of annual or perennial herbs. Nohoanu occurs in subalpine shrubland (with silver leaves), wet forests, bogs, and montane grasslands, all of which are in naturally higher, cooler elevations. The flowers are simple and funnel-shaped. Most of the native nohoanu have white flowers that are pollinated by native moths except for *G. arboreum*, which has curved magenta flowers pollinated by the 'apapane (a native honey creeper). The leaves are alternate, egg-shaped, green, hairy or silvery ½–2 inches long, with finely toothed edges. The flowers and seeds form above the foliage for easier access for pollinators and broader seed dispersal. There is one brownish-red seed per carpel (ovule-bearing structure). If you are not in the appropriate elevation or do not have access to a cool-room, I recommend that you do not collect plant materials or seeds, because the native geraniums need the cool temperatures found in higher elevations to thrive in cultivation.

Entire Range: Hawaiian endemic

Wild Habitat: Nohoanu occurs in subalpine shrubland (with silver leaves), wet forests, bogs, and montane grasslands, all of which are in higher, cooler elevations

Habit: Branching or decumbent shrubs or subshrubs



***Geranium multiflorum* flowering – Maui — KRW**

Mature Height: 3–40 dm

Stem/Trunk: Crowded internodes, some rooting at the nodes, with dried stipules persistent on branches; reddish to black, some gray; some with slender stems

Leaves: Leaves are alternate, entire with the major veins parallel most of their length; apically toothed or serrate. Leaves have stipules and petioles.

Inflorescence/Flower: Flowers occur in cymes that are terminal, axillary or compound; with five sepals, five petals (white, cream, magenta, or white with purple veins), and distinct stamens, ovaries in multiples of five. The corolla is either zygomorphic (bilaterally symmetrical) or actinomorphic (radially symmetrical)

Fruit: The fruit is a schizocarp (a fruit that splits into separate carpels at maturity), and the carpels with their long persistent styles (awns) split off elastically at the base of the central axis (Heywood 1978)

Seed: The seeds are small, dark brown, brown to reddish-brown and they have no endo-sperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the dry fruits when they are mature and browning. Keep them dry in a paper bag until cleaned.
- To clean the seeds, separate the seeds from the carpels by hand.
- Surface sow the small reddish seeds onto moist sphagnum moss or onto a mix of fine black cinder. Keep them under an intermittent mist system schedule that is on during daylight hours (6 AM to 6 PM).
- Or keep the flats in a cool, moist, covered, and shaded area. Do not allow the flats to dry out.

GERMINATION

- Germination may take one to six months for all viable seeds to sprout.
- Wait until the small seedlings have at least four to six true leaves.
- Then transplant them into 2-inch pots with a mix of 3 parts black cinder to 1 part peat moss or 1 part potting mix (3:1).
- Keep the seedlings in a cool, shaded area with plenty of ventilation.
- Repot the seedlings into 4-inch pots when they have outgrown 2-inch pots. This may take about six months.

CUTTINGS

- Follow the directions for softwood tip cuttings carefully. Remember, if the material dries out, the cutting will not root. Use rooting powder No. 1 for woodier stems or no rooting powder at all for greener material.
- Do not collect cutting material if the plant is blooming or in seed, because the cutting material is weaker.

OUTPLANTING

- Your plants will be ready for outplanting when they have outgrown a 4-inch pot, which may take about a year.
- For the bog species, choose a site with a lot of soil moisture that is also in partial shade.
- For the alpine species choose a site in the cool, dry higher elevations.
- These plants are not easy to grow and maintain in the landscape. They need lots of monitoring and care.

PESTS

- No troublesome pests have been noted in the higher elevations. I am sure if you tried to grow the native *Geranium* at lower elevations many pests such as slugs, mealybugs, and scales would find these plants delicious.

GESNERIACEAE

(AFRICAN VIOLET FAMILY)

GENUS:

Cyrtandra

HAWAIIAN NAMES:

Haʻiwale; kanawao keʻokeʻo; hahala; māpele; ulunahele; ʻilihia

SPECIES:

The latest treatment of Hawaiian *Cyrtandra* recognizes sixty-one endemic species (Wagner et al. 2012 update), which are found on all of the main islands. There is still taxonomic work in progress to sort out *Cyrtandra* taxa, and no doubt the number of species that are recognized may change in the future. The majority of species are ranked as vulnerable, rare, endangered, or extinct in the wild (Wagner et al. 1999).

Shady

Range
Hawaiian Endemic

Description
perennial herb, shrub, or small tree

Propagation
seeds and cuttings



***Cyrtandra cyaneoides* flowering – Kauaʻi — DL**

GENERAL DESCRIPTION

It is believed that the sixty-one species currently recognized as Hawaiian endemics evolved from possibly only four to six independent colonizers from Malaysia or other South Pacific islands. *Cyrtandra* show exceptional diversity, polymorphism, and adaptation among the native genera in the Hawaiian Islands. In some cases there has been apparent crossing into many different hybrid forms within very confined geographical areas (Wagner et al. 1990). They are encountered naturally in wet, shady gulches throughout the islands as upright, slender, softwood shrubs anywhere from 1–25 feet tall, mostly in rain forests. The leaves are more or less succulent and velvety, and come in many shapes and sizes, from whorled to opposite, small to large, long and narrow to broad and heart-shaped. Their tubular flowers are whitish and develop from the leaf axils, some grow close to the ground, and others high above the foliage, all adapted to accommodate their habitat and pollinators. White fleshy berries contain numerous tiny tan to brown seeds, which are tasty to birds and easily dispersed by them. The seeds of the ancestors to the present Hawaiian *Cyrtandra* arrived to the islands on the feathers or in the crops of birds.

Entire Range: Hawaiian endemic



Cyrtandra paludosa fruit — JO

Wild Habitat: Shaded wet to mesic forests and gulches, mesic valleys, diverse mesic forests, lowland wet forests, and along streams and stream beds

Habit: Perennial herbs, shrubs, or rarely small trees

Mature Height: 0.3–7.6 m in height

Stem/Trunk: Stems are rounded or angular, covered with hairs or sometimes smooth.

Leaves: The leaves are simple, opposite or whorled, rarely appearing alternate; the upper surfaces of the leaves are usually without hairs or glands, otherwise they can have fine hairs on the surface. The undersides of the leaves are usually covered with soft hairs that appear like velvet and these can be longer or denser along the leaf veins. The leaves often have leaf stalks but sometimes grow directly from the stem

Inflorescence/Flower: The flowers are perfect, singular or numerous in cymes, occurring in the upper leaf axils, sometimes at the base of the stems; the calyx are two to five lobed, the corolla is usually two-lipped and a variety of colors from white, yellow, green, orange, reddish, purplish, or streaked. The corolla can be bell-shaped, trumpet-shaped, funnel-shaped, or tubular with the upper lip having two lobes and the bottom lip having three lobes; five stamens, and a superior ovary

Fruit: Pulpy white berries, usually ovoid, ellipsoid to cylindrical

Seed: The seeds are minute (usually less than about 1 mm long), numerous, ellipsoid and the seed surface reticulate (like a network) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the mature white berries when they are soft and easily removed from the plant.
- Keep the pulpy fruits moist in a plastic bag until they are cleaned.
- Separate the seeds from the pulp as directed for small pulpy seeds.
- Do not store these seeds (due to loss of viability); sow them right away once they have been cleaned.

- No pretreatments are necessary. Surface sow the tiny seeds on moist sphagnum moss, or onto a mix made up of 3 parts fine rinsed black cinder to 1 part peat moss (3:1). Keep them under a mist system (set on a schedule of 6 AM to 6 PM).
- Make sure the media surface does not stay too moist because damping-off can occur. When this happens it will kill the seedlings.
- An alternative is to keep the flats in a cool, covered, shaded area, which is watered every other day.
- Keep a watchful eye for slugs looking for a quick meal. If you see them or signs of them, apply slug bait as recommended.

GERMINATION

- Germination may take two to four months for all viable seeds to sprout.
- Once they germinate, start foliar feeding them monthly using a dilute solution of ½ tablespoon of foliar feed to 1 gallon of water.
- These very small seeds grow into very small delicate seedlings.
- Wait another five to six months before transplanting them into 1–2-inch pots.
- Use a moist, well-draining mix made up of 3 parts black cinder to 1 part peat moss or 1 part potting mix (3:1).
- Keep them in a protected cool, shaded area with good ventilation.
- Repot them into larger pots and add new mix every four to six months, when they have outgrown their pots.
- Keep them in the shade, and fertilize them with 8-8-8 NPK every four months, or foliar feed them monthly.

CUTTINGS

- Collect softwood cuttings in the spring when the plants are not in flower or seed.
- Apply rooting powder No. 1 at the base ends of the cuttings.
- Follow the directions for softwood cuttings and cutting transplanting.
- Keep these cuttings moist at all times.
- These plants are from wetter environments and require more care to survive in cultivation.

OUTPLANTING

- It is time to outplant *Cyrtandra* when it has outgrown a 1–2-gallon pot, which can take about one to two years.
- Choose a site in the shade with moist, well-draining soil and amend the soil with cinder or compost. Cinder facilitates drainage while compost helps hold moisture in the soil.
- Fertilize the plants with small amounts of 8-8-8 NPK fertilizer or foliar feed them monthly.
- Water them in, and then water them when it is dry; check on your plants often to monitor the soil moisture. These plants are worth the extra care.

PESTS

- Slugs love to eat the foliage. Remove them by hand and sprinkle slug bait around, as recommended.
- Red spider mites can colonize the undersides of *Cytrandra* leaves. To manage them, apply horticultural oil spray; follow the directions on label carefully.
- Root mealybugs are small white woolly bugs that can infest the roots of *Cyrtandra*; to control them, apply systemic pesticides as recommended.

GOODENIACEAE

(GOODENIA FAMILY)

GENUS:

Scaevola

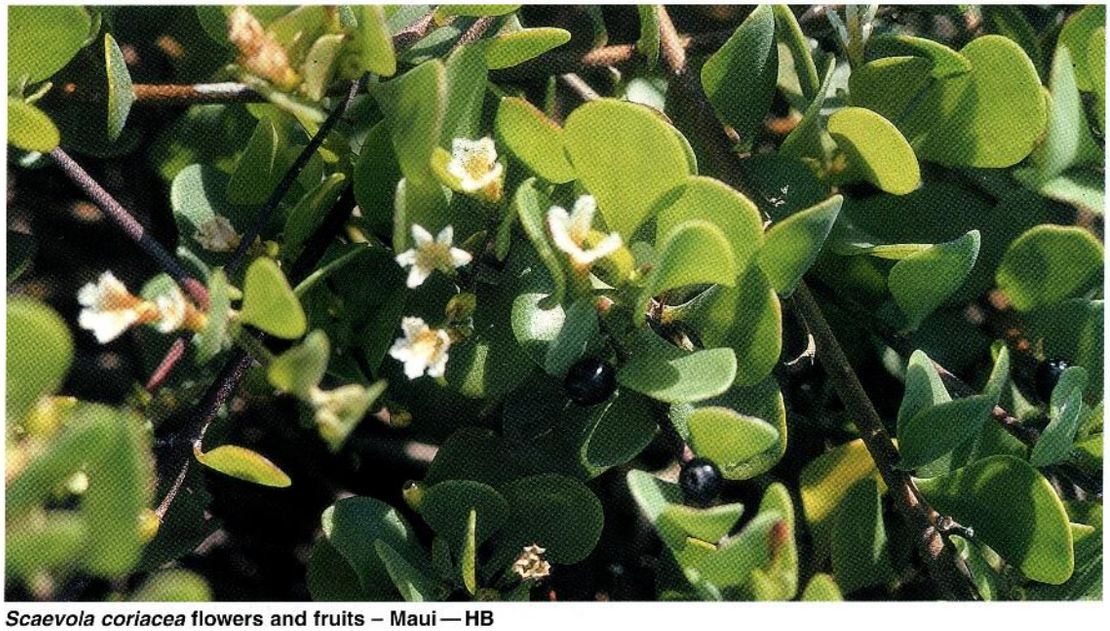
HAWAIIAN NAMES OF COASTAL SPECIES:

Naupaka kai; (dwarf) naupaka

HAWAIIAN NAMES OF MOUNTAIN SPECIES:

Naupaka kuahiwi; 'ohe naupaka

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
S. chamissoniana	—	end (Mo, L, M, H) wet forest
S. coriacea	E	end (HI exc. Ka) coastal
S. gaudichaudiana	—	end (K, O) wet forests
S. gaudichaudii	—	end (HI exc. Ni, Ka) dry forest shrubland
S. glabra	—	end (K, O) wet forests
S. hobdyi	R	end (M) wet forest
S. kilaueae	R	end (H) mesic forests
S. mollis	—	end (K, O, Mo) wet forests and boggy areas
S. procera	—	end (K, Mo) wet forests
S. taccada (syn: *sericea*)	—	ind (HI) common coastal plant



***Scaevola coriacea* flowers and fruits – Maui — HB**

Sun Requirements
Species specific

Range
Endemic or Indigenous[1]

Description
ground cover to small tree

Propagation
seeds and cuttings

1: Range differs for each species.

GENERAL DESCRIPTION

The diverse native naupaka occur as woody, low-growing perennial herbs on the coast to small trees in the cooler mountains. They are easily recognized by their fragrant flowers that appear to be only a "half" flower, that ranges in color and size according to species from white, yellow, purplish, to pink. The leaves cluster near the branch ends and occur in many forms, depending on habitats (if coastal, the leaves are succulent; if mountainous, the leaves are more leathery).

It is believed that the island naupaka are of three independent colonization events: *S. glabra*, which has a distinct seed structure, resembling 'iliahi seeds; *S. taccada*, which has white pulpy fruit; and the other species, which have small black pulpy fruits. They each arrived to the Hawaiian archipelago in different ways. The white-fruited naupaka kai's fruits floated to the islands as they still do today, and the purple fruited mountain species may have arrived with birds. This genus produces hardy plants if they are grown in habitats similar to their natural ones.



***Scaevola glabra* flowers – Kaua'i — KRW**

Entire Range: Indigenous (*S. taccada*) to tropical and subtropical Pacific and Indian Ocean coasts, in Hawai'i common throughout the Archipelago except Gardner Pinnacles, Necker, and Nihoa. The remaining *Scaevola* species are Hawaiian endemics.

Wild Habitat: Coastal beach, dry shrubland to mesic or wet forests

Habit: Perennial herbs, shrubs, or small trees

Mature Height: 0.5–4 m in height

Stem/Trunk: Stems are semi-woody to woody, with prominent nodes

Leaves: The leaves are simple, alternate and with the margins either entire or toothed. They are variable in shape and thickness according to how the species has adapted to its habitat: coastal species have more succulent leaves; forest species have more leathery leaves.

Inflorescence/Flower: The flowers are perfect, irregular (appearing as a "half-flower"), axillary, solitary or in cymes, and with bracts. The calyx and the corolla are in fives, there are five stamens, an inferior ovary, and an exerted, protruding style. The flowers are shaped like a funnel and they look like they have been torn in half longitudinally.

Fruit: The fruits are pulpy, two-celled, and are usually a one-seeded drupe

Seed: The seeds are usually one per fruit and have an oily endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the ripe fruit when it is soft white or dark purple. Keep them moist in a plastic bag until cleaning.
- To clean the seeds, separate the seeds from the pulp (one seed per fruit) as recommended for medium pulpy fruits.
- To prepare the seeds for sowing, first soak them in tap water for twenty-four to thirty-six hours. *S. taccada* seeds naturally float; the other seeds sink if they are viable.
- Sow them onto a mix made up of 3 parts perlite to 1 part potting mix (3:1) or 3 parts black cinder to 1 part peat moss (3:1) for *S. glabra* or *S. mollis*.
- Keep the seed flats in a covered, shaded area for the mountain species, and in partial sun for the beach species. Keep the seed flats protected from heavy rains and wind.

GERMINATION

- Germination occurs in about two months to one year for all viable seeds to sprout. *S. glabra* may take up to six months to germinate.
- They are ready to be transplanted when at least four to six true leaves have developed.
- Transplant them into 2–4-inch pots depending on the root ball size. Use a well-draining mix according to the species: the beach species like a drier mix, while the mountain species prefer a wetter mix, but they all require the media to be well-draining.
- Keep the mountain naupaka seedlings in the shade to partial sun. The beach naupaka seedlings should be moved in a week after potting to full sun to harden them off.
- Foliar feed your plants monthly, or apply an 8-8-8 NPK fertilizer every six months.
- Repot the plants into larger pots and add new mix when the plants grow twice as tall as the pots.



***Scaevola kilaueae* flowering – Hawai'i — JJ**



Variegated naupaka — KLR

CUTTINGS

- To propagate naupaka by cuttings, take the softwood tip cuttings from new spring growth for the mountain naupaka and *S. coriacea*. Follow the directions for softwood cuttings and do not allow the cutting material to dry out at any time.
- *S. taccada* can be easily propagated from cuttings. To do this, collect the softwood tip or semi-hardwood cuttings in the morning, and cut them at about 7-inch intervals; remove all of the lower foliage and cut the top foliage in half. Then they can be outplanted right into the sand to root, if the proper irrigation is supplied. Or stick them in a rooting bed with a mix made up of 3 parts perlite to 1 part vermiculite (3:1) and rooting powder Nos. 3 or 1. Oasis cubes also work well instead of mixes, although they may be hard to find.
- The cuttings will root in about two to three months. When rooted, transplant them into 2–4-inch pots according to their root size.
- Use a well-draining mix; treat them the same as recommended for potted seedlings.

OUTPLANTING

- The mountain naupaka will be ready for outplanting in about a year; the beach naupaka will be ready for outplanting in about six months.
- Choose a site according to the wild habitat requirements such as dry full sun for the beach species, and shady, wet conditions for the mountain naupaka.
- Monitor the plants closely to meet these requirements and water them when it is dry. Use common sense and do not water when it is wet.
- The mountain species are weaker and need more care and monitoring after they are outplanted.

PESTS

- If mites infest the naupaka, apply horticultural oil as recommended, or apply a systemic pesticide to the media if aphids and other sucking insects attack your plants.
- Control ants from the base of the plants as recommended.

GUNNERACEAE

(GUNNERA FAMILY)

GENUS:

Gunnera

HAWAIIAN NAMES:

'Ape'ape; hāhā; 'ape

SPECIES	STATUS	HAWAIIAN RANGE
G. kauaiensis	—	end (K)
G. petaloidea	—	end (K, O, Mo, M, H)

Shady

Range
Hawaiian Endemic

Description
herb

Propagation
seeds



***Gunnera petaloidea* flower bud – Maui — KRW**

GENERAL DESCRIPTION

'Ape are giant perennial herbs that can grow up to 20 feet high, with large, hairy, rounded dark-green leaves that can reach as much as 6.5 feet across. They occur in deep shady gulches or on steep cloud-swept slopes in wet rain forest areas. A long flower cluster develops from the branch ends and bears many tiny greenish-red flowers, developing into small rounded yellow-orange fruits that contain tiny angled seeds. An interesting aspect of the 'ape is the symbiotic relationship the plant has with blue-green algae, which lives in its stem and petiole bases. The algae acts like a nitrogen fixer by providing available nitrogen to the 'ape allowing this unusual plant to live in a niche, which has nitrogen-poor soils. Unless you live in the higher cool elevations of 4,000 feet or more, or have a cool-room, I recommend that you do not grow these plants because they will probably not survive the hot, dry conditions of the lower elevation during the summer months.

Entire Range: Hawaiian endemic

Wild Habitat: Wet forest to wet cloud forests and slopes

Habit: Giant, fleshy perennial herb with gigantic leaves; spreads vegetatively by rhizomes

Mature Height: 1.5–3.5 m in height

Stem/Trunk: Stems will trail on the ground without taking root; they can reach up to 6 m in length and are about 12–15 cm in diameter



***Gunnera kauaiensis* flower – Kaua'i — KRW**

Leaves: The leaves are gigantic, palmate, and shaped somewhat like a heart or a kidney; the leaves are lobed palmately; large axillary scales are often mistaken for true stipules (which are lacking)

Inflorescence/Flower: The Hawaiian *Gunnera* flowers are perfect or sometimes intermingled with unisexual flowers on the same inflorescence (*G. petaloidea*); they are inconspicuous, and occur in axillary inflorescences in numerous spikes, and each flower is greenish to rose magenta with an inferior ovary

Fruit: The fruit can be red to purple (*G. kauaiensis*), or yellow to orange (*G. petaloidea*) and a leathery or a fleshy drupe, globose, three-angled, and about 3–4 mm in diameter

Seed: The seeds are small (1–2 mm long), angular, and the embryo is embedded in an oily endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the fruits when they are mature and purple to orangish in color; keep them moist in a plastic bag.
- Separate the small seeds from the pulp as recommended for small pulpy seeds.
- No pretreatment of the small seeds is necessary; these seeds do not maintain their viability if stored in desiccation, but can be stored in the refrigerator for a few months.
- When you are ready to plant the seeds, surface sow them in shallow flats on moist sphagnum moss or onto a mix made up of 3 parts fine black cinder to 1 part fine peat moss (3:1); keep the flats under a mist system, and monitor them for slugs.
- Keep the seed flats in a covered, cool shaded area.

GERMINATION

- Germination may take one to six months for all viable seeds to sprout; when they do, transplant them into 2-inch pots when at least four true leaves develop.
- Use a moist, well-draining mix made up of 2 parts black cinder to 1 part peat moss (2:1); add a small amount of 8-8-8 NPK fertilizer and foliar feed them monthly with a light solution.
- Repot them when the seedlings are twice as tall as the pots.
- Keep the seedlings and repotted plants in the shade with good ventilation.

OUTPLANTING

- Either keep 'ape in pots in a cool, shaded place, repotting and changing the media every year, or choose a shady, damp site in higher elevations in well-draining soil, out of strong winds (the large leaves can easily tear).
- Water the plants in, then water them only when it is dry.

PESTS

- Slugs can attack the 'ape and will eat them when they are seedlings or plants; if this happens, manage them through hand removal and application of slug bait.

H

HYDRANGEACEAE

(HYDRANGEA FAMILY)

GENUS:

Broussaisia

HAWAIIAN NAMES:

Kanawao; pū'ahanui

SPECIES	STATUS	HAWAIIAN RANGE
B. arguta	—	end (HI exc. Ni, Ka) mesic to wet forest

Partial Sun

Range
Hawaiian Endemic

Description
shrubs

Propagation
seeds and cuttings



***Broussaisia arguta* male flowers – Kaua'i — DL**

GENERAL DESCRIPTION

One of the most common shrubs in the rain forest is kanawao, a dioecious plant that bears either all male or all female flowers on individual plants. This is an adaptation found throughout the Hawaiian Archipelago that reduces inbreeding. The long, broad, rough, dark green leaves are either whorled or opposite and with noticeable reddish midribs and veins, the leaf edges are finely toothed and the younger parts coarsely hairy. Pink to greenish-yellow flowers form in dense clusters at the branch ends. They are very attractive when they are in bloom. The dark maroon fruit contains many small seeds. These form on short stems and they are eaten and dispersed by birds, which is the reason the plant is so common. I have never grown this plant myself but felt that it can be propagated and maintained in a wet shady landscape easily enough.

Entire Range: Hawaiian endemic

Wild Habitat: Wet or mesic forests

Habit: Shrubs

Mature Height: 2–5 m tall

Stem/Trunk: Stems have conspicuous leaf scars; initially they have hairs and they become smooth with maturity

Leaves: The leaves are opposite or in whorls with three leaves per node; each leaf is leathery, oblong-elliptic, and about 20 cm long by 7 cm wide. The upper leaf surface has conspicuous veins, with a



***Broussaisia arguta* female flowers — GDC**

few hairs along them becoming smooth with age; the under leaf surface has raised veins with a hairy surface, mostly along the veins and the leaf margins. The leaf margins also have rounded teeth.

Inflorescence/Flower: Unisexual flowers (functionally dioecious), greenish-blue to pink, greenish-white, yellow to cream colored; in panicles, flower sepals, petals, and stamens in multiples of five, staminate flowers deciduous after flowering

Fruit: Berry-like fruit, with partially inferior ovary, red to maroon, broadly ellipsoid (oval) to subglobose (roundish), 8–12 mm long with whitish flesh

Seed: Numerous seeds aligned horizontally, ellipsoid, with small beaks, and the seed surface reticulate (the surface appearing like a network) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Broussaisia arguta* fruit—JO**

- To propagate from seed, first collect the fruits from an area with many kanawao shrubs growing together to improve your chances of collecting viable seeds.
- The ripe fruit should be soft and maroon in color; keep the fruit moist in a plastic bag until it can be cleaned.
- To clean the seeds, separate the pulp from the tiny seeds as directed for small pulpy seeds.
- Start the seeds fresh; they do not maintain their viability if they are stored.
- Surface sow the tiny cleaned seeds onto a mix made up of 3 parts perlite to 1 part potting mix (3:1); then water the seeds in.
- Keep them in a covered, shaded moist area.

GERMINATION

- Germination may take one to six months for all viable seeds to sprout.
- Once they germinate, and when they have developed at least four true leaves, transplant them into 2-inch pots.
- Use a well-draining mix and keep the seedlings in the shade; then move them into partial sun after one month.
- Repot them when they grow twice as tall as the 2-inch pot into larger pots and add new mix.
- Apply an 8-8-8 NPK fertilizer mixed into the media, or foliar feed them monthly.

CUTTINGS

- Take leafy, softwood cuttings from the top of the plant in mid-spring before they flower or set seed; follow the directions carefully and do not allow the cuttings to dry out at any time.
- Apply a No. 1 or 3 rooting powder with a fungicide which helps control fungal problems in a damp mist system.
- Insert the cuttings into a mix made up of moistened 3 parts perlite to 1 part potting mix (3:1), and keep them under a mist system for best results.
- They will root in three to five months; once rooted, pot them up and treat them the same as directed for the seedlings.

OUTPLANTING

- The seedlings and cuttings will be ready for outplanting when the plants are twice as tall as 1–2-gallon pots.
- Choose an outplanting site that has partial sun, well-draining soil; amend the soil as recommended.
- Monitor your plants often to observe their growth, check on the soil moisture, and look for insect damage.
- Fertilize the plants every six months with 8-8-8 NPK fertilizer or foliar feed them monthly.

PESTS

- Control ants from the base of plants using ant bait. Follow the recommended ant control protocols.
- Slugs may find this plant tasty; control them with slug bait as recommended.

H

HYDROCHARITACEAE

(FROG'S-BIT FAMILY)

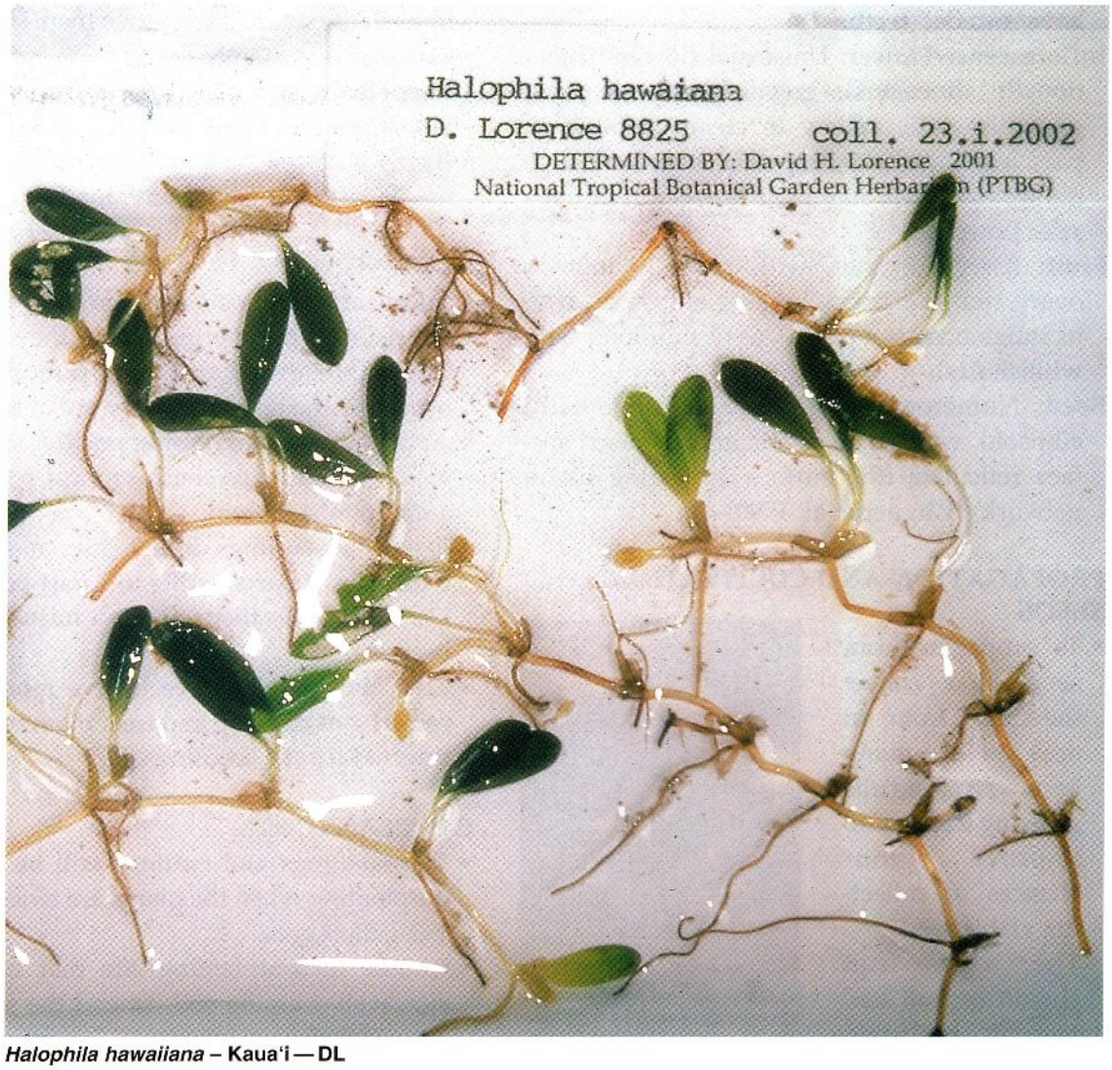
GENUS:	COMMON NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Halophila	**Hawaiian Seagrass**	*H. hawaiiana*	—	end (K, O, Mo, M) sandy reefs or bays

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
submerged creeping plant

Propagation
cuttings



Halophila hawaiiana **– Kaua'i — DL**

GENERAL DESCRIPTION

Halophila s a small relatively rare subtidal seagrass. A submerged, creeping flowering plant with roots that hold into sandy sediments. Found growing wild in saltwater fishponds and along reef flats. The leaves are 1 inch long, with narrow blades and eight to twelve dark striped veins on each side of the midrib. The small flowers are unisexual (either all male or all female). The female flowers mature into roundish fruits with many small rounded seeds that float. *Halophila* grows along an underwater rhizomatous stem that roots freely at the nodes. It is easily propagated by taking rhizome cuttings.

Entire Range: Hawaiian endemic

Wild Habitat: Occurs in salt water in sandy or muddy areas of fishponds and sandy reef flats

Habit: A perennial saltwater herb with creeping stems that root at the nodes

Mature Height: Submerged

Stem/Trunk: Rhizomes extending up to 2 mm in diameter and 3–8 mm long, roots at the nodes

Leaves: Opposite leaves, narrowly obovate to spatulate, each leaf about 20–30 mm long and 6 mm wide, with about ten veins on each side of the midrib

Inflorescence/Flower: Flowers are either male or female (unisexual), flower parts in multiples of three; male tepals white with a dark median stripe, about 4 mm long, on flower stalks about 15 mm long; female flowers with twelve to fifteen ovules, and three styles.

Fruit: Fruits are globose and about 4 mm long

Seed: Seeds are few to numerous and about 1 mm long, the surface reticulate (networked) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

CUTTINGS (RHIZOMES)

- The easiest way to propagate *Halophila* is to carefully dig under the mud or sand the plant is going in, collecting 4- to 6-inch rhizome cuttings or small clumps of the plant. Try not to damage the long roots attached to the rhizomes at anytime.
- Keep the rhizome cuttings or clumps in a sealed plastic bag with some saltwater or in a small cup-like container with saltwater and sand or mud the plant was growing in, until transported to a growing area.
- Use a shallow container about 3 inches high with no holes and fill the bottom with the sand or mud.
- Place the rhizomes into the sand or mud, covering them slightly. Then add the saltwater. Keep the plants in a protected, shaded area.
- The seagrass should root and start growing in two to four months.
- Move the plants into partial to full sun to help harden them off for outplanting.

OUTPLANTING

- Wait until the seagrass is growing and healthy before outplanting.
- Plant along the edges of saltwater fishponds, a few inches to a few feet deep, as long as sunlight can penetrate the water reaching the *Halophila*.
- Or, keep them in a sunny area in a shallow flat with a sandy soil mix and fresh saltwater.
- Be careful not to disturb or damage the plant and its rhizomes, stems, and roots while transplanting or outplanting.



Halophila hawaiiana – **Kaua'i — PC**

H

HYDROPHYLLACEAE

(WATERLEAF FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Nama	**Hinahina kahakai**	*N. sandwicensis*	V	(Le, HI exc. Ka) sandy coastal sites

Full Sun

Range
Hawaiian Endemic

Description
annual or perennial herb

Propagation
seeds



***Nama sandwicensis* flowers – Maui — HB**

GENERAL DESCRIPTION

Nama is a short-lived annual or perennial herb growing in sandy soils in coastal habitats. These small charming herbs spread over the ground in small clumps about 8 inches or so around. They have pink, purple-blue to whitish flowers. The alternate, thick, succulent leaves have tiny curved hairs and do not have leaf stalks. They evolved a mechanism to help the leaves retain water during prolonged dry spells, earning them the nickname "water-leaf." The many tiny yellowish-brown seeds develop in oval-shaped capsules. These are best collected when they are brownish and dry. If Nama is protected from introduced plants and pests, they are excellent plants for coastal restoration projects.

Entire Range: Hawaiian endemic

Wild Habitat: Scattered and uncommon, occurring in sandy soils, strand or coastal vegetation, rarely on dry shrubland

Habit: Annual to short-lived perennial, branching and creating mats up to 2 dm in diameter

Mature Height: Prostrate

Stem/Trunk: Stems are prostrate with a dense covering of hairs and freely branching, forming mats

Leaves: The small, simple, alternate leaves are thick and spatulate, about 20 mm long by 5 mm wide; the leaf surface has a thick covering of appressed hairs; the leaf margins are entire and revolute (rolled over and toward the underside of the leaf) and tapering at the base. These small leaves do not have leaf stalks.



***Nama* habit with Laysan Finches, Laysan Is.—F&KS**

Inflorescence/Flower: One or two flowers emerge out of the leaf axils on short flower stalks (about 3 mm long), the calyx lobes are oblong and about 4 mm long when young and increase in size to about 6 mm long by the time the flowers mature into fruits; the flower corolla can be purplish-blue, pink, or white with yellow on the throat; the tube is about 5 mm long, hairy without, smooth within; the corolla lobes spread to about 2 mm long; stamens occur within the corolla and only develop about 1 mm beyond the base. The leeward island populations appear to have lost their gene for corolla color and are an albino form

Fruit: The fruits are brown capsules both oblong and circular in shape, about 4 mm long

Seed: Many seeds are produced (twenty to sixty); they are yellowish-brown, small (about 0.5 mm long), shaped like grains of rice, and have shallow pits (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate *Nama* by seed, collect dry capsules when they are brownish and keep them in a dry paper bag until cleaning.
- Separate the seeds from the capsules as recommended for small dry seeds.
- Start the seeds fresh to achieve higher germination rates.
- No pretreatment of the seed is necessary.
- Surface sow the small seeds onto a mix made up of 3 parts perlite to 1 part potting mix (3:1) or 3 parts perlite to 1 part vermiculite (3:1).
- Water the seeds in and keep them in a covered area to control the moisture; water them every two days.

GERMINATION

- Germination can occur in one to three months for all viable seeds to sprout.
- Before transplanting, wait until at least six true leaves develop (about one to two months).
- When ready, transplant your *Nama* into 2-inch pots. Be careful because the thin sensitive root systems can be easily damaged.
- Use a well-draining sandy soil mix made up of 3 parts black cinder to 1 part washed beach sand (3:1) with a small amount of 8-8-8 NPK fertilizer mixed in. Water them weekly and be careful not to over water; they will rot.
- Repot the seedlings into larger shallow pots and add new media every six months, or outplant them.

CUTTINGS

- *Nama* are short-lived herbs. I recommend that you grow them from seeds because your plants will live longer.

OUTPLANTING

- *Nama* can be outplanted in three to six months or when your plants have outgrown the 2–4-inch pots.
- Choose a coastal site or a similar habitat and plant them in sandy, rocky soil with full sun.
- Amend the planting holes for free-draining soil, as recommended.
- Use a small amount of 8-8-8 NPK fertilizer or foliar feed the plants monthly.
- Water in the plants at first, then only water in times of prolonged drought or when the plants feel or look very dry.
- *Nama* will regenerate itself naturally by seed. Watch for small seedlings sprouting near the parent plants in the pots or in the outplanting site.

PESTS

- Slugs love to feed on these succulent herbs. Apply slug bait as recommended.
- Root mealybugs can infest *Nama;* control them with systemic pesticides as recommended.
- Ants can infest the pots and occur around the plants and in the ground; control them with ant bait as recommended.

I

IRIDACEAE

(IRIS FAMILY)

GENUS:
Sisyrinchium

HAWAIIAN NAME:
Mau'u lā'ili; mau'u 'hō'ula-'ili

COMMON NAME:
Blue-eyed grass

SPECIES	STATUS	HAWAIIAN RANGE
S. acre	R	end (M, H)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
perennial or annual herb

Propagation
seeds



***Sisyrinchium acre* flower – Maui — RH**

GENERAL DESCRIPTION

The endemic yellow flowering *Sisyrinchium* is found in open areas that are dry to wet subalpine shrubland 5,000–9,650 feet elevation. They have slender, fibrous roots. The leaves are 6–15 inches long, narrow and grass-like. The winged flower stem develops centrally and is a long, straight, leafless stem with a small cluster of yellow short-lived flowers. The hanging pear-shaped capsules are filled with small, roundish, black seeds deeply pitted on one side. Hawaiians made a bluish dye from the juice of the plant for tattoos, known as uhi (Abbott 1992).

Entire Range: Hawaiian endemic
Wild Habitat: Open, dry to boggy areas and subalpine shrubland
Habit: Seasonal perennial or annual herb

Mature Height: 15–30 cm

Stem/Trunk: Flowering stems are unbranched, broadly winged and are only one long internode. Roots are fibrous and slender.

Leaves: Grass-like leaves, slender, all basal and about half as long as the flowering stems; about 24 mm long and about 3 mm wide

Inflorescence/Flower: Flower parts in multiples of three; ovary inferior; flowering stems broadly winged, without leaves attached; flowers many; tepals yellow and about 8 mm long

Fruit: Capsule globose to cylindrical (pear-shaped) and about 7 mm long by 5 mm in diameter

Seed: The numerous small (0.8 mm in diameter) seeds are black, spherical, and have deep pits on one side (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, collect the capsules when they are ripe, dry, and starting to open; keep them in a dry paper bag until cleaned.
- Separate the black seeds from the capsules by hand, opening them up along the natural seams.
- Soak the seeds in tap water for one to two hours. Sow them in shallow flats filled with a mixture made up of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1) and cover the seeds with an additional ½ inch of mix before watering them in.
- Keep the flats in a cool, shaded, covered area, and water them every other day.

GERMINATION

- It will take between one and six months for all viable seeds to sprout.
- Wait until at least four to six true leaves develop before transplanting.
- Transplant the seedlings into 2–4-inch pots depending on the size of the root ball.
- Use a well-draining mix that is on the moist side, for example, a mix made up of 3 parts black cinder to 1 part peat moss (3:1) and with a small amount of 8-8-8 NPK fertilizer mixed in.
- Keep the seedlings in a shaded area for one to two months, and then move to an area with more sun to harden them off.
- In six months to a year they are ready for outplanting or repotting into larger pots with new media.



***Sisyrinchium* acre flowers and seed pods – Maui — F&KS**

OUTPLANTING

- Choose a site in higher elevations at least 300 feet elevation, with partial to full sun and with well-draining moist soil; amend the soil as recommended.
- Plant them under or near other plants for extra protection.
- Water them in, and then water weekly until new growth appears.
- Monitor them often for soil moisture or poor drainage.
- Fertilize with 8-8-8 NPK fertilizer every six months or foliar feed them monthly.
- These plants will regenerate themselves if the seeds are left to fall onto the ground, or if you collect and propagate them.

PESTS

- Ants can infest *Sisyrinchium* and they tend to farm insects at the base of the plants; control the ants and associated pests as recommended.

J

JOINVILLEACEAE

(JOINVILLEA FAMILY)

GENUS:

Joinvillea

HAWAIIAN NAME:

'Ohe

SPECIES	STATUS	HAWAIIAN RANGE
J. ascendens subsp. *ascendens*	—	end (K, O, Mo, M, H)

Shady

Range
Endemic and Indigenous[1]

Description
clumping perennial herb

Propagation
seeds and cuttings

1: Range differs for each species.



***Joinvillea ascendens* subsp. *ascendens* fruits – Kaua'i — SP**

GENERAL DESCRIPTION

The wet forest 'ohe is a rare, clumping, perennial herb 5–10 feet tall that grows in the wild as separate individuals or in small populations. These plants grow along an underground rhizomatous (underground stem) system. The bristly leaf blades are long, narrow, have deep grooves, and are pointed at each end. The tiny flowers appear at the ends of the plants on a branched flower cluster, maturing into many small, rounded, green fruits, maturing to bright orange. The seeds germinate in cultivation easily enough, but soon die. I believe there may be beneficial microorganisms in their native soil that the plant depends on for its survival. If these are not present, the plant may die. Viable seeds germinate because they live on the stored foods in the seed; when this is used up, they essentially starve to death. Seedlings in the wild are also rare; it is possible that the soil may be losing this organism due to habitat disturbances from introduced animals such as cattle, goats, or pigs or introduced harmful microorganisms. More research is needed to better understand the relationships between soil microorganisms and native Hawaiian plants.

Entire Range: Endemic to Hawai'i

Wild Habitat: Occurs on ridges, wet forest, and along intermittent streams; in Hawai'i, 300–1,250 m elevation

Habit: Erect rhizomatous perennial herbs

Mature Height: 1.5–5 m tall

Stem/Trunk: Stems cylindrical or compressed, hollow except at the nodes, unbranching, and smooth

Leaves: Leaf blades are narrow, elliptic about 60 cm long by 12 cm wide, plicate with about ten pleats; both surfaces have scattered bristles

Inflorescence/Flower: Flowers are small, perfect, radially symmetrical, and in multiples of three; the panicles occur in branched (three to five) pyramids, which are about 10–40 cm long; there are six tepals in a series of two; six stamens, superior ovary with three carpels, and three styles

Fruit: The green fruits are about 4 mm in diameter and can ripen to a reddish-orange or dark color with maturity; the fruit has a thin outer exocarp, a pulpy middle layer, and a hard and bony endocarp, which encases the seed(s)

Seed: The seeds are one to three per fruit, globose and wrinkled (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the fruits when they are ripe, reddish-orange, and falling off. Keep them moist in a plastic bag until cleaned.
- Collect some of the native soil the plant is growing in also.
- Remove the pulp from the small seeds as recommended for small pulpy seeds.
- Start with fresh seeds as they do not tolerate storage.
- Soak the seeds in tap water for one to two hours.
- Surface sow them onto a dry mix made up of 3 parts perlite to 1 part potting mix (3:1); mix in a small amount of the native soil collected, then water the seeds in.
- Keep them in a covered area; water every day keeping the mix on the moist side.
- Or keep them under an intermittent mist system.

GERMINATION

- Germination can take from one to three months; wait another two months before transplanting, and be sure at least four true leaves have developed.
- Then carefully transplant them into 2-inch pots filled with a mix made up of 3 parts black cinder to 1 part peat moss (3:1) and some of the native soil; also add a small amount of 8-8-8 NPK fertilizer.
- Keep them in the shade, and water every other day.
- Do not be too disappointed if all of the seedlings die; keep records of what you did and share the information with others if your seedlings survive to maturity.

CUTTINGS (rhizome)

- To propagate 'ohe clonally, take rhizome cuttings as recommended and keep them in a sealed plastic bag. Pot them as soon as possible.
- Place the 3–5-inch pieces in a shallow flat filled with a mixture made up of 3 parts black cinder or 3 parts perlite to 1 part peat moss (3:1), cover the rhizomes slightly so they will not dry out.
- Keep them in the shade under an intermittent mist system or water them every day.
- They should root in about two to three months. Care for the cuttings the same as you would the seedlings.

OUTPLANTING

- Choose a wet, shady site with well-draining soil, and amend as recommended.
- Outplant with other plants for extra protection, giving them all room to grow.
- Keep the soil on the moist side and monitor the area often.

PESTS

- Control infestations of ants and any associated pests from the base of the plant with bait or spray as recommended.

JUNCACEAE

(RUSH FAMILY)

GENUS:
Luzula

COMMON NAME:
Woodrush

SPECIES	STATUS	HAWAIIAN RANGE
L. hawaiiensis var. *glabrata*	—	end (K, Mo, M)
L. hawaiiensis var. *hawaiiensis*	—	end (K, L, M, H)
L. hawaiiensis var. *oahuensis*	—	end (O)

Full Sun

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds



***Luzula hawaiiensis*—JO**

GENERAL DESCRIPTION

Luzula is a perennial herb that grows in dense, low tufts with gray, silky leaves and fibrous roots. The young plants are densely hairy and become hairless with age. The small, dense flower clusters form at the nodes and along the stem growing from the middle of the plant. Later reddish-brown three-angled capsules develop, each containing about three small, round brownish seeds. These rushes are found growing in mesic to subalpine shrublands on open rocky cliffs. An easy way to distinguish between rushes and sedges is to remember that (usually) "rushes are round and sedges have edges" (referring to the stem in cross-section).

Entire Range: Hawaiian endemic

Wild Habitat: Occurs in open, rocky sites, slopes, cliff ridges, and open area in mesic forests and shrublands, and grasslands

Habit: Perennial tufted herb with fibrous roots

Mature Height: 0.8–70 dm long

Stem/Trunk: The stems are erect and marked with fine parallel lines

Leaves: The leaves are soft, basal, the blades flat, one to two per stem, and linear, about 20 cm long and 5–10 mm wide; the margins are covered with dense hairs which become smoother as the plant ages

Inflorescence/Flower: The flower parts are in multiples of three, the flowers are small (about 3 mm long), compact, and surrounded with bracts (bracteoles); the flowers develop in inflorescences, which can be terminal (at the ends) and also lateral (growing from the axis of a node); the perianth is pale yellowish-brown to dark brown

Fruit: The capsules are pale reddish-brown and glossy and dehisce into three parts

Seed: There are three small seeds per capsule, which are globose or ovoid, red to dark brown, and about 1–2 mm long, sometimes covered with a shriveled whitish surface (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the reddish-brown capsules when they are mature, dry, and splitting open.
- Keep them dry in a paper bag until they can be cleaned. To retrieve the seeds, open the capsules by splitting them along the seams.
- Seeds can be stored up to seven years in a desiccation chamber.
- Sow the small seeds onto a mix made up of 3 parts perlite to 1 part potting mix (3:1); cover the seeds by adding a light layer of mix, then water them in.
- Keep them in a shaded, covered area and water them every other day.

GERMINATION

- Germination can take from one to three months for all viable seeds to sprout; wait until four leaves form before transplanting.
- When the seedlings are ready for transplanting, use 2-inch pots filled with a well-draining mix, then water them in and keep them in a cool, shaded place.
- Foliar feed them monthly and repot them into larger pots adding new mix every three to six months.
- Move them into more sun to harden them off and prepare them for outplanting.

OUTPLANTING

- To outplant, first choose a site in the higher elevations with full sun and a well-draining yet moist soil.
- Dig up and amend the planting hole as recommended; also amend with small amounts of 8-8-8 NPK fertilizer.
- Plant them along with other plants. They are also attractive when planted in a black cinder bed around larger rocks.
- Water them in, and then water them weekly until they are well established and growing well.

PESTS

- Control any infestations of ants and any associated pests by applying systemic pesticides and using ant bait as recommended for the treatment of ants.

L

LAMIACEAE

(MINT FAMILY)

GENUS

Haplostachys

HAWAIIAN NAME:

Honohono

SPECIES	STATUS	HAWAIIAN RANGE
H. bryanii	Ex	end (ex Mo)
H. haplostachya	E	end (H, ex. K, M)
H. linearifolia	Ex	end (M, Mo)
H. munroi	Ex	end (L)
H. truncata	Ex	end (M)

Full Sun

Range
Hawaiian Endemic

Description
erect perennial herbs

Propagation
seeds and cuttings



***Haplostachys haplostachya* flowers and seeds — KLR**

GENERAL DESCRIPTION

Haplostachys are endangered, erect perennial herbs. *Haplostachys bryanii* is believed to be extinct on Molokai, along with other species in this family. Apparently, *Haplostachys* are especially tasty to introduced grazing animals, other threats include fire, agriculture and alien plants. *H. haplostachya*, survives today in a small, isolated population on the Big Island (Hawai'i), and is protected through the Endangered Species Act by federal listing as an endangered species. These attractive mints have the typical square stems and opposite leaves, which are long, narrow, and heart-shaped. The leaves are covered with dense, whitish woolly hairs which reflect excessive sunlight to help tolerate the tropical climate. The flowers are charming: large, white, and curved, and arranged at the top of the plant along a single spike. If pollinated, small, round nutlets develop. They grow in dry, cindery soils in high, dry elevations. Isolation, inbreeding, and drought conditions in degraded habitats have caused low viability and low germination rates in the honohono seeds.

Entire Range: Hawaiian endemic

Wild Habitat: Barren ridges, sandy substrates, and cinder cones at sea level to 1,585 m

Habit: Erect perennial herb

Mature Height: 3–6 dm

Stem/Trunk: Square stem, with a dense, white tomentum (fuzzy-hairy surface)

Leaves: Leaves are simple, opposite, fleshy, heart-shaped at the petiole and becoming narrower and pointed at the apex. The upper surfaces are heavily networked. The petiole

and the leaves are covered with a soft layer of short hairs, which can make them appear white.

Inflorescence/Flower: The small, white, bilaterally symmetrical curved flowers grow in racemes about 10–30 cm long

Fruit: Fruits are dark brown "nutlets" about 3.5–4 mm long

Seed: Small seeds with a thick, hard pericarp (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the fruits (nutlets) when they are mature, brownish, and shedding from the plant. Keep them dry in a paper bag until you are ready to soak them for planting.
- Soak the seeds in hand-hot or tap water for one hour or scarify them.
- Surface sow the seeds on a dry mix of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1) in shallow flats; water the seeds in.
- The seeds can be stored for nine or more years in desiccation chambers, refrigerator, or at room temperature, although they will lose some viability.
- Keep the flats in a covered area and water them every other day.

GERMINATION

- Be patient. The honohono may take three to eight months for all viable seeds to sprout.
- Wait until at least four true leaves develop, then transplant into 3–4-inch pots depending on the size of the root ball.
- Use a mix of 3 parts black cinder to 1 part potting mix (3:1) with a very small amount of 8-8-8 NPK fertilizer mixed in.
- Keep them in the shade for two weeks and then move them to a sunnier location to slowly harden them off.
- Repot them into larger pots whenever the plant is twice as tall as the pot it is growing in.
- Foliar feed the seedlings monthly, or every six months use small amounts of 8-8-8 NPK fertilizer.

CUTTINGS

- For successful cuttings, the plant must be healthy. Do not collect your material when the plants are in bloom, seeding, or during drought; water the plant a day or two before taking the material.
- Collect the softwood or tip cuttings 3–5 inches long in the early morning hours. Follow the directions for softwood cuttings.
- Remove all of the lower foliage and cut the top leaves in half. Keep them in a sealed plastic bag until you are ready to start them.
- Recut the bottom end of the cutting just below a node and insert it into a shallow flat of fine black cinder or a mix of 3 parts perlite to 1 part potting mix (3:1). No rooting powders are needed. Water the cuttings in initially, then water every other day.
- Keep the flats in a covered, shaded area until they root. This may take from one to three months.
- Transplant and care for them the same as you would for seedlings.

OUTPLANTING

- When plants have outgrown a 1-gallon pot, or when the plants are twice as tall as the pots, it is time to outplant them.
- Choose a site in a sunny location with well-draining rocky soil and amend the soil as recommended.
- Water them in, and then monitor the site for adequate moisture, watering them during dry spells.
- If you do not allow the plant to bloom and make seeds you can prolong its life for a few years. To accomplish this, for the first couple of years, cut off any flower stalks that grow, and this will strengthen the plant.
- Foliar feed the plants monthly, or apply small amounts of 8-8-8 NPK fertilizer every six months.

PESTS

- Control infestations of ants and associated pests by applying systemic pesticides to the media and using ant bait as recommended for the treatment of ants.

L

LAMIACEAE
(MINT FAMILY)

GENUS:
Phyllostegia

HAWAIIAN NAMES:
Ulihi; kāpana; kīponapona

SPECIES:
There are currently thirty-five endemic species of *Phyllostegia* found on all main Hawaiian Islands. Their current status ranges from extinct/endangered to rare to apparently secure (Wagner et al. 2012).

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
climbing woody vine to shrub

Propagation
seeds and cuttings



***Phyllostegia ambigua* flowers – Maui — JO**



***Phyllostegia velutina* flowers – Kona — DL**

GENERAL DESCRIPTION

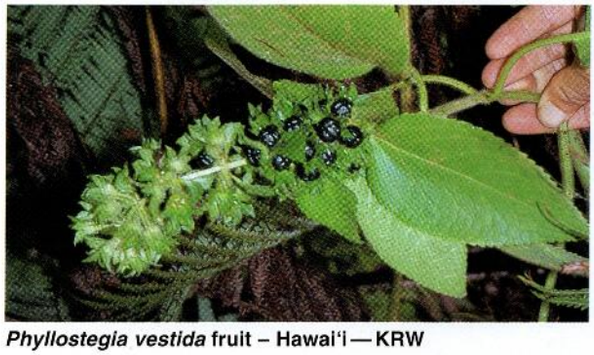
Some of the Hawaiian mints have seeds that are covered with a fleshy layer that turns purple when they ripen to attract birds that will feed on and disperse the seeds. This is unlike other members of the mint family, which have dry fruits. *Phyllostegia* grow primarily in mesic to wet forest habitats as nonaromatic perennial herbs, climbing woody vines, or as small shrubs with square stems. Flowers are usually fragrant, growing on long spikes at the top of the stems. They are easier to propagate and grow than *Haplostachys* and have larger populations. Hybridization is apparently uncommon in *Phyllostegia*. The nutlet fruits are dark green and turning purplish-black when mature. They each contain one drupe-type seed with a hard seed coat.

Entire Range: Hawaiian endemic
Wild Habitat: Mesic to wet forest habitats
Habit: Nonaromatic perennial herbs, liana, or subshrubs
Mature Height: 3–50 dm
Stem/Trunk: The stems are square, erect to decumbent (growing along the ground without rooting), branching many times to sparsely, and they are usually pubescent (covered with hairs)
Leaves: Leaves are simple, opposite, with petioles, membranous to leathery, smooth to networked, variously pubescent, and glands present

Inflorescence/Flower: Flowers range from fragrant to nonaromatic; they occur on pedicels, and are irregular and bilaterally symmetrical; they occur in racemes or racemose inflorescences. The flowers can be white, pink, purple, or red.

Fruit: The fruits, or "nutlets," can be dark green to black drupes with a fleshy exocarp (outer fruit layer) and slightly winged margins

Seed: Small tan seeds (Wagner et al. 1990)



***Phyllostegia vestida* fruit – Hawai'i — KRW**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits (nutlets) when they are mature and are a purplish color. Keep them moist in a plastic bag until you are ready to plant them.
- Separate the pulpy fruit from the small tan seeds as recommended for small pulpy seeds.
- Start the seeds fresh; no pretreatment is necessary.
- Surface sow the seeds on a dry mix of 3 parts perlite to 1 part potting mix (3:1); water the seeds in.
- Keep them in a shaded, covered area and water every other day.

GERMINATION

- It may take two weeks to three months for all viable seeds to sprout.
- Wait another month to transplant them into 2-inch pots filled with well-draining mix.
- Keep them in a shaded area for a month, then move them into partial shade.
- Repot them using new mix into larger pots when they are twice as tall as the pots they are in.
- Foliar feed them monthly and/or apply an 8-8-8 NPK fertilizer every six months.

CUTTINGS

- Collect tip or stem cuttings of softwood, 5–7 inches long with at least three nodes. Reduce the lower foliage and cut the top foliage in half.
- Keep cuttings moist in a sealed plastic bag until you are ready to start them. Do not allow the cuttings to dry out or be exposed to direct sunlight at any time.
- Insert the bottom node into a mix made up of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1); no rooting powder is needed.
- Water the cuttings in initially, then water every other day. Keep the flats in a shaded, covered area.
- The cuttings should take root in two to three months.
- Pot them up and care for them the same as for seedlings.

OUTPLANTING

- Your *Phyllostegia* will be ready for outplanting when it grows twice as tall as its pot, or in about six months to one year.
- Choose a site that is in partial shade. Under a tree with other plants works well.
- Plant them in well-draining soil; amend the soil as recommended. Polymer added to the soil keeps the soil moist.
- Water the plants in, then water when it is dry, and monitor them for a few months. After they are established, they need little care.

PESTS

- Ants and red spider mites can infest *Phyllostegia*. If they do, control them as recommended.

LAMIACEAE

(MINT FAMILY)

GENUS:

Plectranthus

HAWAIIAN NAME:

'Ala'ala wai nui

COMMON NAMES:

Spurflower; Hawaiian mint

SPECIES	STATUS	HAWAIIAN RANGE
P. parviflorus	—	ind (HI exc. Ka) rocky coastal to dry forests

Full Sun–Partial Sun

Range
Indigenous

Description
perennial herb

Propagation
seeds and cuttings



***Plectranthus parviflorus*—KLR**

GENERAL DESCRIPTION

Plectranthus is the easiest native member in the mint family to grow and maintain. It actually becomes weedy, and seedlings will sprout all around the plant. When this happens they can be easily transplanted into pots or relocated. *Plectranthus* grows as a small spreading herbaceous perennial 6–8 inches in height, in dry, exposed, rocky locations. The soft, light-green leaves have a surface of fine hairs. Tiny, purplish flowers densely whorl along a singular upright spike that jets above the foliage from the ends of stems, developing into dry brownish nutlets (fruits) which fall to the ground and germinate readily.

Entire Range: Hawaiian endemic

Wild Habitat: Dry, exposed, and rocky sites

Habit: Erect or ascending perennial herb

Mature Height: 15–20 cm

Stem/Trunk: *Plectranthus* can have a fleshy, tuberous base, or sometimes a woody base, with stems and branches that are fleshy and covered with a dense layer of hairs

Leaves: The leaves are simple, opposite, and can vary from thick to thin and papery, with lobed margins, and are covered with fine hairs



Plectranthus parviflorus – Maui —F&KS

Inflorescence/Flower: The irregular and bilaterally symmetrical pale blue flowers occur in terminal racemes which are simple or branch at the base

Fruit: The fruits (nutlets) are small, about 0.8 mm long, and ovoid

Seed: The seeds are small and hard (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, collect the fruits when they are dry and brownish and are shedding from the plant. Keep them dry in a paper bag.
- Start the seeds fresh; no pretreatments are needed.
- Surface sow the seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1), and then water the seeds in.
- Keep the flats in a covered area.

GERMINATION

- It may take two weeks to two months for all viable seeds to sprout.
- Wait until at least four true leaves develop before transplanting seedlings into 2-inch pots of well-draining mix.
- Keep the seedlings in the shade for about a week, and then move them into partial sun to help harden them off.
- Repot into larger pots with new media when plants are twice as tall as the pots they are growing in.

CUTTINGS

- Any stem portion of this plant will root as long as there are two to three nodes and the lower foliage is removed; no rooting powders are necessary.
- Follow the directions for softwood cuttings; do not allow the cuttings to dry out.
- Use a mix made up of 3 parts perlite to 1 part potting mix (3:1) in shallow flats.
- Water the cuttings in.
- Once the cuttings have rooted, in about one to two months, transplant them into 3–4-inch pots with well-draining soil.
- When the plants are twice as tall as the pots they are growing in, it is time to repot.

OUTPLANTING

- When the plants have outgrown a 4-inch or 1-gallon pot, it is time to outplant them into a site with full to partial sun.
- The site must have well-draining soil, which can be amended as recommended.
- Water the plants in. Monitor them weekly, then water them during dry periods until they are established.
- *Plectranthus* are easy to maintain and will regenerate themselves in the garden.

PESTS

- *Plectranthus* may get infested with ants, root mealybugs, and scales. Apply a systemic pesticide to the media and control the ants and pests as recommended.

LAMIACEAE

(MINT FAMILY)

GENUS:

Stenogyne

HAWAIIAN NAMES:

Māʻohiʻohi; puaʻainaka; mōhihi

SPECIES:

There are currently twenty-three endemic species of *Stenogyne* found on all of the main Hawaiian Islands. Their status ranges from extinct, endangered, vulnerable, and rare, to apparently secure (Wagner et al. 2012).

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
climbing vines

Propagation
seeds and cuttings



***Stenogyne kamehamehae* flowers – Maui — SP**

GENERAL DESCRIPTION

Multiform *Stenogyne* occur in mesic, wet, to dry subalpine habitats, as climbing perennial vines that branch. They sometimes grow along the ground or rarely as erect herbs. The leaves and flowers of *Stenogyne* are nonaromatic. Leaves are larger and lush in the wetter moist habitats and smaller and rougher when they occur in drier locations with full sun. Flowers come in many colors according to species from white, pink, red, purple, and maroon all the way to greenish-yellow, and they develop from the leaf nodes. *Stenogyne* looks similar in growth habit to *Phyllostegia* and it is likely they share the same ancestor.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic, wet, dry, and subalpine

Habit: Nonaromatic perennial vines or erect perennial herbs, sometimes woody at the base

Mature Height: Vines 1–2 m long; herbs 2–7 dm height

Stem/Trunk: Stems square, and can be climbing or decumbent (growing along the ground without rooting), branching, often covered with hairs

Leaves: Simple, opposite, sometimes lobed, membranous, smooth to networked, sometimes covered with fine hairs, growing from leaf stalks or sometimes leaves occur directly off of the stem

Inflorescence/Flower: Flowers irregular, bilaterally symmetrical, odorless, axillary, ranging in color from white, pink, red, purple, dark maroon, cream, yellow or green.

Fruit: Fruits (nutlets) turn black at maturity with slightly winged margins; obovoid, the outer layer of the fruit is fleshy

Seed: Small dry hard seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Stenogyne* sp. flowers – Hawai'i — JJ**

- To propagate by seeds, first collect the fruits (nutlets) when they are ripe, and black in color. Keep them moist in a plastic bag until they are cleaned.
- Remove the black pulp as directed for small pulpy seeds.
- The cleaned seeds can be stored in the refrigerator or at room temperature, although they will lose some viability.
- Start seeds fresh for best results; no pretreatment is necessary.
- Surface sow the seeds on a dry mix of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1) in shallow flats; water the seeds in.
- Keep the flats in a covered area and water them every other day.

GERMINATION

- Be patient; it may take one to eight months for all viable seeds to germinate.
- Wait until at least four true leaves develop, then transplant them into 3- to 4-inch pots depending on the size of the root ball.
- Use a light well-draining mix, with a very small amount of 8-8-8 NPK fertilizer mixed in.
- Keep the wet forest species (*S. kamehamehae*, *S. cranwelliae*, etc.) protected in the shade; in a few weeks move the species from the drier habitats to a sunnier location to slowly harden them off.
- Repot into larger pots whenever the plant is twice as tall as the pot it is growing in.
- Foliar feed the seedlings every one to three months and use a small amount of 8-8-8 NPK fertilizer added to the potting mix.

CUTTINGS

- For successful cuttings, do not collect your material when the plants are in bloom, seeding, or during drought.
- Collect the softwood or tip cuttings 3–5 inches long in the early morning hours. Follow the directions for softwood cuttings.
- Remove all of the lower foliage and cut the top leaves in half. Keep them in a cool place, in a sealed plastic bag until you are ready to start them.
- Recut the bottom end of the cutting just below a node and insert it into a shallow flat of 3 parts perlite to 1 part potting mix (3:1). No rooting powders are needed. Water the cuttings in initially, and then keep moist.
- Keep the flats in a covered, shaded area until they root. This may take from one to three months.
- Transplant and care for them the same as you would for seedlings.

OUTPLANTING



***Stenogyne angustifolia* fruit — DR**

- When plants have outgrown a 6-inch to1-gallon pot, it is time to outplant them.
- Choose a site with well-draining soil and amend the soil as recommended.
- Water them in, and then monitor the site for adequate moisture, watering them during dry spells.
- Polymer (p.37) amended into the hole will help species from the wetter habitats survive dry spells.
- Foliar feed the plants monthly, or apply small amounts of 8-8-8 NPK fertilizer every six months.

PESTS

- Control infestations of ants and associated pests by applying systemic pesticides to the media and using ant bait as recommended for the treatment of ants.
- Slugs will feast on the seedlings and older plants; control them as recommended.

L

LAURACEAE

(LAUREL FAMILY)

GENUS:

Cassytha

SPECIES	STATUS	HAWAIIAN RANGE
C. filiformis	—	ind (HI exc. Ka)

HAWAIIAN NAMES:

Kauna'oa pehu; kauna'oa uka; kauna'oa mālolo; kaunoa; mālolo; pōlolo

Full Sun

Range
Indigenous

Description
parasitic vines

Propagation
seeds



***Cassytha filiforme* fruit — DB**

GENERAL DESCRIPTION

Parasitic *Cassytha* is a slender, thread-like vine with haustoria, which are specialized roots that penetrate into host tissues to absorb nutrients. *Cassytha* occurs in coastal habitats on a variety of host plants. It has orange, green to brown stems that contain chlorophyll. The stems twine over trees, shrubs, or rocks; the leaves are small scales along the stems. Tiny round flowers develop directly on the stem, later developing into tiny round green fruits that are eaten and dispersed by birds. This parasitic vine resembles *Cuscuta* or dodder, known as kauna'oa lei, which has yellow stems that do not contain chlorophyll. I feel that this plant is best grown from seed, and it is easier to induce growth on the host plant as a seedling. The name *Cassytha* is derived from "kesatha" which is Aramaic for "a tangled wisp of hair."

Entire Range: Indigenous: Pantropical and Hawai'i
Wild Habitat: Coastal habitats
Habit: Parasitic vine with small haustoria
Mature Height: Not applicable

Stem/Trunk: Stems are green to orange, smooth and thin

Leaves: Leaves have been reduced to small scales

Inflorescence/Flower: The flowers develop along the stems without flower stalks, some develop into spikes about 1–2 cm long, and each is subtended by a bract. The floral tube is shallow and later envelops the fruit. Flower parts are in multiples of three

Fruit: Each round green fruit is enclosed in the persistent floral tube

Seed: Small dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the fruit when it is greenish-brown and shedding from the vine. Keep them dry in a paper bag.
- Remove the seeds from the fruit by hand, or as recommended for small dry seeds.
- Start the seeds fresh for best results. Soak them in tap water for one hour; viable seeds should sink.
- Use a mix of 3 parts perlite to 1 part potting mix (3:1) in a shallow flat, and water the seeds in.
- Keep them in a protected area away from heavy rains or wind.
- Water them every two days and when they are dry.

GERMINATION

- It will take about one to three months for all viable seeds to sprout.
- Wait another month after they sprout to transplant them into 4-inch pots with a host plant that is also in the seedling stage. Beach naupaka shrubs or naio trees work well.
- Use a well-draining mix such as 3 parts black cinder to 1 part rinsed beach sand or 1 part potting mix (3:1).
- Keep the media on the dry side and in the shade; after about two weeks move them into full sun.
- Repot plants together when the host plants (naupaka or naio) are twice as tall as the pots they are growing in.

OUTPLANTING



***Cassytha filiformis* on naupaka – Kure Atoll, HI — F&KS**

- Your plants will be ready to outplant in about six months to one year; they should be growing healthily enough to outplant together.
- Choose a site in full sun and with sandy, well-draining soil. Amend the soil as recommended.
- Water in the plants initially, and then water during times of prolonged drought.
- Monitor your plants weekly to check on their growth, health, and soil drainage.
- Help train your *Cassytha* to grow on and over the host plant.

PESTS

- Control ants if they infest the base of the host plants. Most of the problem insects are protected by ants that farm them for the sweet honeydew they produce. Use systemic pesticides and manage them as recommended.



***Cassytha filiformis* fruit – Kure Atoll, HI — F&KS**

L

LAURACEAE

(LAUREL FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Cryptocarya	Hōlio	*C. mannii*	—	end (K, O)



***Cryptocarya mannii* fruit — JO**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds

GENERAL DESCRIPTION

Hōlio is a 20–30 foot tall tree that occurs in dry to mesic forests 2,000–4,000 feet elevation, on Kaua'i and rarely on O'ahu. The bark is dark brown and pebbly. The thick, leathery, leaves are alternate and occur in many different shapes. The flowers are hairy, small, and gray to yellowish-brown and develop at the branch ends. They mature into an egg-shaped dark fruit that is enclosed by the floral tube and contains one seed which looks a lot like a small avocado.

Entire Range: Hawaiian endemic to Kaua'i and O'ahu

Wild Habitat: Dry to mesic forests

Habit: Tree

Mature Height: 6–9 m

Stem/Trunk: The younger branches are dark brown, smooth with some hairs, while the older branches have a gray, corky layer

Leaves: The leaves are alternate, leathery, and vary in size; they are about 10 cm long by 4 cm wide. They are covered on both sides by fine venation and they have a broad, yellow midrib. The leaf bases and the apices are rounded (narrowed to a point)

Inflorescence/Flower: The flowers are perfect, with a slender floral tube, six conspicuous

petals with a dense pubescence (hairy covering), the flower parts in multiples of three. The flowers are yellowish-brown or gray and pubescent (covered with hairs).

Fruit: Fruits are oval, about 3 cm in diameter at maturity, more ellipsoid when young. The fruit is encased in a persistent, ribbed, floral tube

Seed: One seed per fruit (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the fruits when they are mature and green-black in color. Keep them moist in a plastic bag.
- Remove the pulpy layers of the fruit by hand; using a knife can also be helpful.
- Start the seeds soon after they are cleaned; no pretreatment needed.
- Use a mix made up of 3 parts perlite to 1 part potting mix (3:1) leveled; cover the seeds with ½ inch more of the mix, then water the seeds in.
- Keep them covered in a shaded area.

GERMINATION

- It will take from two to four months for all viable seeds to sprout.
- Once they germinate, transplant them into 3-inch pots with well-draining mix as recommended.
- Keep them in full to partial shade; repot them when they are twice as tall as the pot they are growing in.
- Foliar feed them monthly and also apply small amounts of 8-8-8 NPK fertilizer.
- Move them into a sunnier location to help harden them off for outplanting.

OUTPLANTING

- These plants are slow growing, and it may take one to two years before they are twice as tall as a 1- or 2-gallon pot.
- Once they are big enough, choose a site in partial to full sun, which is also protected from strong winds and introduced grazing animals.
- Prepare area so it has well-draining soil by amending the soil as recommended (p.36).
- Plant out the hōlio with other plants, shrubs, subshrubs, and ground covers.
- Fertilize them the same as you did the seedlings.
- Water them in, then water weekly or when they are dry; monitor the plants for problems.
- Hōlio is a sensitive plant that requires extra care to keep it healthy.

PESTS

- If infestation of ants and associated pests occur, control them away from the base of the tree as recommended.

LILIACEAE

(LILY FAMILY)

GENUS: ***Astelia***

HAWAIIAN NAME: **Pa'iniu**

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
A. argyrocoma	—	end (K) epiphytic in diverse mesic to wet forests
A. menziesiana	—	end (HI exc. Ni, Ka) terrestrial - epiphytic in mesic to wet forests and bogs
A. waialealae	—	end (K) epiphytic in diverse mesic to wet forests

Shady

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds



***Astelia waialealae* flowers – Kaua'i — KRW**

GENERAL DESCRIPTION

Astelia is a perennial herb that grows as silvery rosettes on tree branches (epiphytically) in wetter habitats, or on the ground (terrestrially). The conspicuous, long, narrow, silver leaves are covered with small, hairy scales that peel off like skin. The Hawaiians made hat leis from the translucent leaf peels, symbolizing a visit to the volcano (Neal 1965). Flowers form on long branching spikes in an array of colors from yellowish to purplish-red. The plants are dioecious, having male and female flowers on different plants, an attribute that reduces inbreeding. Small orange berries develop at the spike ends in clusters. These are easily accessible to birds which feast on the succulent berries with their small black seeds, and then widely disperse them on the ground and in the trees. Pa'iniu is best grown from seed because seedlings adapt more easily to elevation changes. A mature plant collected from a cool mountain will not be able to adapt to the lower warmer elevations.

Entire Range: Hawaiian endemic
Wild Habitat: Wet and mesic forests
Habit: Terrestrial or epiphytic, perennial herb
Mature Height: (Leaves) 1–100 cm long
Stem/Trunk: Rhizomatous (underground stem)
Leaves: Silvery green to scaly leaves with parallel veins; scaly surfaces sometimes peeling off; leaf blades long and thin
Inflorescence/Flower: Flowers are small, unisexual (dioecious), and arranged in inflorescences with terminal racemose branches on simple scapes (leafless flower stalk), subtended by bracts. The inflorescences are equal or extend beyond the leaves. Flower parts in multiples of three, superior ovary (female flowers). The perianth can be green, greenish-brown, yellowish to purple, or red
Fruit: Orange pulpy berry
Seed: Small black seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seeds, first collect the berries when they are ripe, soft and orange. Keep them moist in a plastic bag until cleaning.
- Separate the small black seeds from the pulp as directed for small pulpy seeds.
- Start the seeds fresh; no pretreatments are necessary.
- Surface sow the seeds onto moist sphagnum moss, fine black cinder, or a mix of equal parts of the two in a shallow flat.
- Keep them under a mist system or mist daily with a fine spray. If you are in a drier location, place the seed flat in a sealed plastic bag to create a moister environment.
- Keep them in the shade, out of direct sunlight.

GERMINATION

- It may take two to four months for all viable seeds to sprout.
- Wait until four to six leaves develop before transplanting seedlings into 2-inch pots filled with a mix of 3 parts black cinder to 1 part peat moss or 1 part potting mix (3:1).
- Keep seedlings moist and in the shade.
- They will be ready for repotting into a 4-inch pot when they have outgrown a 2-inch pot or can be mounted onto a hāpu'u log or onto hāpu'u chunks (tree fern trunks) and kept moist.
- Foliar feed them monthly.



***Astelia menziesiana* fruit – Maui — KRW**

OUTPLANTING

- Choose a site in the moist shade in loose, cindery soil. If it is an epiphyte, attach the hāpu'u chunk to a shade tree, and keep it moist.
- Water when it is dry; monitor the plant closely for proper moisture.
- The pa'iniu can also be maintained in a container pot in the greenhouse with partial sun.
- Continue to foliar feed your plant monthly, or use fish emulsion every three months.

PESTS

- For ants in the pot or at the base of the plant, control as recommended.

L

LILIACEAE

(LILY FAMILY)

GENUS:

Dianella

HAWAIIAN NAMES:

'Uki'uki; 'uki

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
D. sandwicensis	—	ind (HI exc. Ni, Ka) dry shrubland to wet forests



***Dianella sandwicensis* fruit — DB**

Full Sun – Partial Sun

Range
Indigenous

Description
clumping perennial herb

Propagation
seeds

GENERAL DESCRIPTION

'Uki is a common clumping perennial herb occurring in many habitats in the undergrowth with long, leathery, sword-shaped leaves 1–3 feet long, and 1 inch wide. These leaves were braided by the Hawaiians for cordage and used in house construction. Small, bluish-white flowers form on soft spikes that hang among the leaves. The bright blue fruits are eaten and dispersed by birds. The Hawaiians strung them into beautiful seed leis and also used the blue fruit extract as a dye for kapa (Abbott 1992). This is an easy plant to grow from their small black seeds and is best outplanted as an understory planting with trees, shrubs, and ground covers.

Entire Range: Indigenous to Hawai'i and extending at least to the Marquesas

Wild Habitat: Open to shady sites, wet to mesic forest, dry shrubland, grasslands, and on lava

Habit: Perennial herb, forming clumps from the stems

Mature Height: 5–20 dm tall

Stem/Trunk: 'Uki has rhizomes which spread close to the ground and are about 1.5 cm in diameter

Leaves: Tough, flexible leaves, linear-lanceolate, smooth and green, 30–100 cm long and about 2–3 cm wide with a prominent keeled midrib and entire margins

Inflorescence/Flower: Blue to white perfect flowers with yellow stamens, flower parts in multiples of three occurring on panicles about 30 cm long and branching

Fruit: Deep blue berries, round and about 8 mm long

Seed: Seeds black, angular, and about 3 mm long with a brittle but hard seed coat (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the mature fruit when it is soft and dark blue in color; keep the fruit moist in a plastic bag.
- Separate the small black seeds from the purple pulp as directed for small pulpy seeds.
- Start the seeds fresh; no pretreatments are necessary, sow on a mix of 3 parts perlite to 1 part potting mix (3:1); add ½ inch of additional mix on top of the seeds.
- Water the seeds in, then water every one to two days and do not let the mix dry out.
- Keep them in a covered, shaded area.



Dianella sandwicensis **flowers — F&KS**

GERMINATION

- It may take two to four months for all viable seeds to sprout.
- Wait until at least four leaves develop before transplanting into 2-inch pots filled with a well-draining mix.
- Water them in, and keep them in the shade.
- Repot every four months into larger pots or when they have grown twice as tall as their pots.
- Foliar feed them monthly, or apply small amounts of 8-8-8 NPK fertilizer every six months.

OUTPLANTING

- Your plants will be ready for outplanting in about six to eight months, when they have outgrown a 6-inch or 1-gallon pot.
- Choose a site with partial to full sun and with well-draining soil. Amend the soil as directed.
- Water in the plants, then water weekly until they become established, which is indicated by new growth.
- Continue to fertilize with foliar fertilizer, and/or apply a slow-release 8-8-8 NPK fertilizer.

PESTS

- Ants and their associated pests can infest your plants in the pots or at the base of the 'uki; if they do, apply a systemic pesticide and control them as recommended.

L

LOGANIACEAE

(LOGANIA FAMILY)

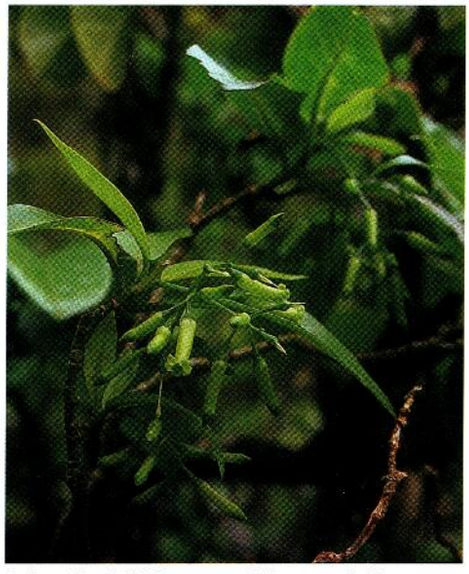
GENUS:
Labordia

HAWAIIAN NAME:
Kāmakahala

SPECIES:
There are nineteen endemic species found on all of the main Hawaiian Islands (Wagner et al. 2012).



***Labordia hedyosmifolia* flowers – Hawai'i — JJ**



***Labordia tinifolia* var. *wahiawaensis* flowers – Kaua'i — SP**

Shady

Range
Hawaiian Endemic

Description
shrub to small tree

Propagation
seeds and cuttings

GENERAL DESCRIPTION

Kāmakahala occurs as a vine-like shrub to a small branching tree chiefly in damp, shady forests at about 5,000 feet elevation. The opposite dark-green leaves are glossy above and pale green on the lower surface, with or without hairs. The flowers are single or clustered at the branch tips, and are yellowish-orange to greenish in color and five-parted. The dry capsules split open along the seams when they mature exposing the tightly clustered dark brown seeds. These plants grow best as understory plants in shady moist environments with damp, well-draining soil.

Entire Range: Hawaiian endemic

Wild Habitat: Diverse mesic to wet forest, bog margins or hummocks, or cloud-swept summits

Habit: Shrubs or small trees, sometimes sprawling or scandent

Mature Height: Various

Stem/Trunk: Stems various from herbaceous to woody, often angled, erect or vine-like, and branching

Leaves: Leaves are opposite, smooth or with fine hairs, dark green above, pale green on the lower surface, entire or slightly toothed margins

Inflorescence/Flower: Flowers functionally unisexual (plants dioecious), in various forms of axillary inflorescences, five to six flower calyx lobes, corolla tube with five to seven lobes and usually flaring at opening, yellow, greenish-yellow, or sometimes white, thick and fleshy, ovary superior (female)

Fruit: Two-valved capsule, green or white, dry or slightly fleshy with a thick exocarp (outer fruit layer or skin)

Seed: Numerous seeds, brown to black, with a thick and fleshy endosperm (Wagner et al. 1990)



***L. lydgatei* flowers – M. Clark USFWS**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are green or white and have begun to split along the seam.
- Keep the capsules dry in a paper bag until cleaned.
- Separate the small dark seeds from the capsules by hand.
- Start the seeds as soon as possible to avoid loss of viability.
- Soak in tap water for one hour, after which the viable seeds should sink.
- Surface sow them onto moist sphagnum moss or onto a mix of 3 parts fine black cinder to 1 part potting mix or 1 part peat moss (3:1).
- Keep them under a mist system or in a covered, cool, moist, shaded area.

GERMINATION

- All viable seeds should sprout within two to six months.
- Once the seedlings form, foliar feed them monthly.
- Seedlings take months to grow large enough to transplant into 2-inch pots. Be very patient.
- Use a well-draining soil mix of 3 parts black cinder to 1 part peat or 1 part potting mix (3:1).
- Keep the seedlings in a cool, shaded area; repot them every six months into larger pots, adding new soil each time.
- Continue to foliar feed them monthly; monitor them for slugs that love to eat fleshy seedlings.

CUTTINGS

- Collect softwood cuttings in the early morning hours; follow the protocols for softwood cuttings.
- Use a well-draining mix of 3 parts perlite to 1 part potting mix (3:1) or use a fine black cinder.
- Keep them under a mist system that is on only during daylight hours (6 AM to 6 PM).
- Keep them out of direct sunlight during the rooting period.
- They should root in three to five months.
- Handle and transplant them as directed for seedlings.

OUTPLANTING

- It is important to choose an outplanting site in a cooler, high-elevation area with well-draining soil.
- Plant them under other plants; try to create a forest-type setting.
- Monitor your plants closely for soil moisture and the proper amount of shade.
- Foliar feed them monthly and/or add small amounts of slow-release 8-8-8 NPK fertilizer.

PESTS

- Ants can infest your plants along with their associated pests; if they do, follow the recommendations for using a systemic pesticide and control the ants with bait.
- Slugs can eat the foliage and seedlings; if you see them or signs of them, apply slug bait.
- Red spider mites can occur on the undersides of leaves; see recommendations for controlling mites and rotate the use of horticultural oils.

MALVACEAE

(MALLOW FAMILY)

GENUS:
Abutilon

COMMON NAME:
Flowering maple

HAWAIIAN NAME:
Ko'oloa 'ula (*A. menziesii*)

SPECIES	STATUS	HAWAIIAN RANGE
A. eremitopetalum	E	end (L)
A. menziesii	E	end (O?, L, M, H)
A. sandwicense	E	end (O)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds and cuttings



***Abutilon menziesii* flowers — KLR**

GENERAL DESCRIPTION

The endangered *Abutilon* occurs naturally in the dry forests of the islands. These threatened shrubs are surely special gifts from mother nature, with their soft grayish-green, heart-shaped leaves and gorgeous, hanging, five-petaled flowers. *A. eremitopetalum* (meaning hidden-petaled) has cup-shaped greenish flowers whose petals are hidden inside a large, tubular, half-inch long calyx. *A. menziesii* (ko'oloa 'ula) is a charming shrub that displays its colorful petals; they are small and dangling and can be colored maroon, pink, reddish, or yellow. When I've grown ko'oloa'ula from seed, some of the seedlings come out having different colored flowers than the mother plant. (This may explain why different populations have different color variations). What a special lei these flowers would make.

In cultivation, *A. eremitopetalum* and *A. menziesii* have cross-pollinated, producing a hybrid of the two. The resulting leaves look more like *A. eremitopetalum*, but the flowers are a cross of the two, having a pinkish-green color and petals that emerge half way out of the calyx. *A. sandwicense* has the largest gray-green leaves of these three and has the most fascinating flowers of all. They are large, oddly shaped, yellowish-green flowers with some reddish-brown to them. The whole shrub has a tendency to lie on the ground and is very weak in strong winds. Many small, brown, fuzzy seeds develop in dry schizocarps (fruit);



***Abutilon* hybrid – NTBG — KLR**

these turn brown and split open when mature. There are introduced seed weevils that eat the seeds, both in the wild and in cultivation. Native *Abutilon* species are threatened in the wild because of habitat destruction, but they would make very interesting specimen plants in our landscapes; they are easy to grow from viable seed.

Entire Range: Hawaiian endemic (Lana'i, East Maui, Hawai'i, and O'ahu)

Wild Habitat: Dry forests and steep slopes

Habit: Branching shrub

Mature Height: 1–3 m

Stem/Trunk: Woody and branching

Leaves: Leaves are simple; heart-shaped, and appear velvety due to the fine, star-shaped hairs covering the leaf surfaces and leaf stalks; leaf margins have teeth

Inflorescence/Flower: Flowers perfect, solitary and axillary; flower parts in multiples of five; calyx bell-shaped to cup-shaped (and hiding the petals in the *A. eremitopetalum*); staminal column shorter than the petals, the flowers of *A. menziesii* range from various shades of red to maroon or pink; the petals of *A. sandwicense* are yellowish-green with reddish-brown in them.



***Abutilon menziesii* flowers — JO**

Fruit: Schizocarp with individual chambers for each seed (mericarp)

Seed: Seeds are small, dry, brown, and kidney-shaped, and can be either smooth or fuzzy (Wagner et al. 1990)

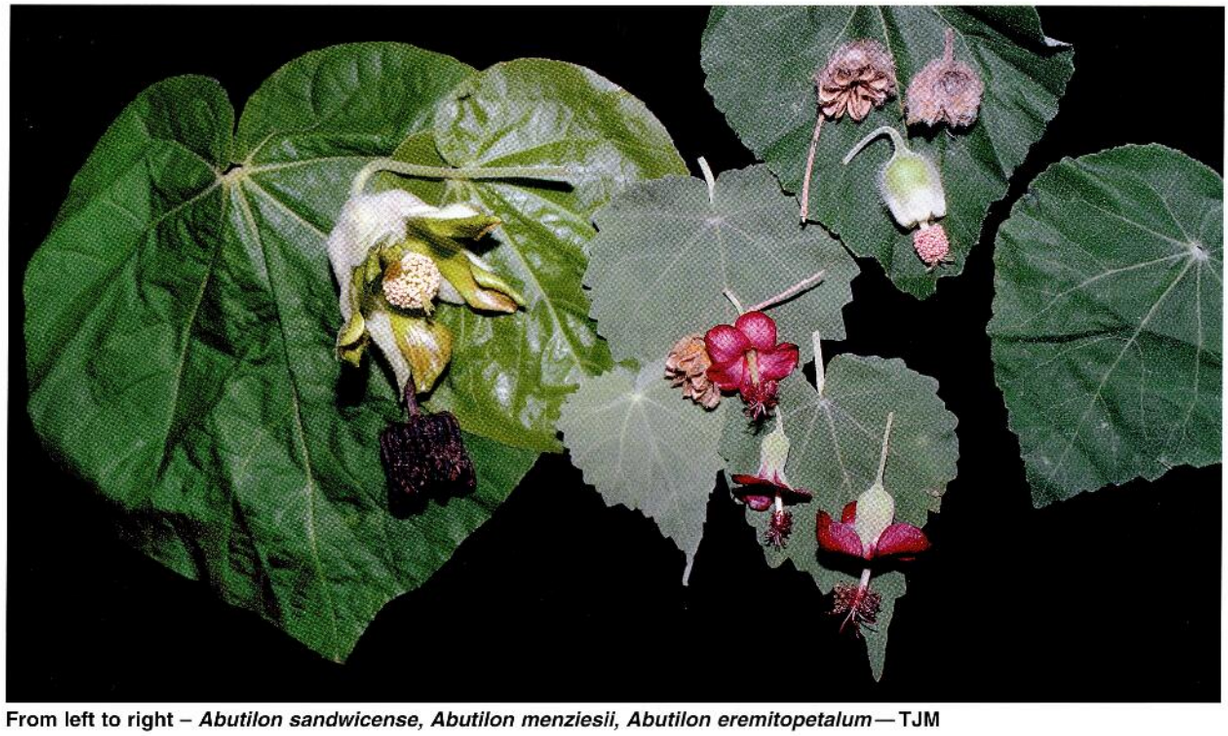
PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the ripe fruits when they are dry and brown; keep them dry in a paper bag until cleaned.
- Remove the small fuzzy seeds by hand as soon as possible to avoid insect damage.
- The seeds can tolerate being stored at room temperature, refrigerated, or in desiccation for up to eight years.
- Soak the seeds in tap water for twelve to twenty-four hours; the seeds will float at first because of the fuzzy hairs that trap air bubbles, and then sink with time. If any seeds are floating after the soaking period discard them.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1), add seeds, then cover with ¼ inch of additional mix.
- Water the seeds in and then water every other day; keep them in a covered area.

GERMINATION

- Germination may occur in two weeks to three months for all of the soaked viable seeds; seeds not soaked can take five months to a year to germinate.
- Wait until four to six true leaves develop, then transplant them into 2–3-inch pots.
- I recommend using a well-draining cindery mix.
- Keep the seedlings in a shaded area; repot them into larger pots with new media when they become twice as tall as the pots they are growing in.
- Move them into more sun slowly to harden them off for outplanting.



From left to right – *Abutilon sandwicense, Abutilon menziesii, Abutilon eremitopetalum*—TJM

CUTTINGS

- Take semi-hardwood to softwood cuttings in the morning hours from healthy plants. If drought stressed the cutting will not root, follow protocols described.
- Remove the bottom leaves; do not let the cuttings dry out at any time.
- Use standard cutting mix, apply rooting powder No 3 to base ends.
- Keep mix moist, watering every other day.
- The cuttings will root in four to six months; handle and pot same as seedlings.

OUTPLANTING

- To outplant, choose a site in full to partial sun that is also sheltered from strong winds.
- Outplant into a well-draining soil and amend the area as recommended.
- Plant with other plants; for example, 'ilima (*Sida fallax*) makes a good ground cover beneath other plants.
- Foliar feed them monthly, and/or 8-8-8 NPK fertilizer every three to six months.

PESTS

- Plants in the Malvaceae family are subject to the Chinese rose beetle, which eats holes in the leaves. If they infest your *Abutilon*, treat the plants with systemic pesticides as recommended.
- Slugs can infest your plants and eat the seedlings; use slug bait and follow the protocols for control.
- Red spider mites on the underside of leaves can cause yellowing; if this is the culprit, spray with horticultural oil.
- Whiteflies can infest the underside of the leaves; if they do, wash them off with a strong spray of water or treat them with horticultural oil and/or systemic pesticides.
- **Note**: all of these pests will weaken your plants, and can kill them in extreme cases.

MALVACEAE

(MALLOW FAMILY)

GENUS:

Gossypium

COMMON NAME:

Hawaiian cotton

HAWAIIAN NAMES:

Ma'o; huluhulu

SPECIES	STATUS	HAWAIIAN RANGE
G. tomentosum	V	end (HI exc. H)

M



***Gossypium tomentosum* flower – Maui — HB**

Full Sun

Range
Hawaiian Endemic

Description
low-growing shrub

Propagation
seeds and cuttings

GENERAL DESCRIPTION

Ma'o is a low-growing shrub 2–6 inches high with attractive bright yellow solitary flowers (leaves used by the Hawaiians to make a light green dye (Abbott 1992)). They were once common in dry, rocky, coastal sites but are now vulnerable to the development of these seaside areas. The leaves are three- to five-lobed and are covered with a white down; they occur in dry areas with full sun. Medium-sized capsules contain two to four fuzzy seeds that are covered with short, brown, cotton fiber boles (which is not used commercially for cotton). Ma'o has been used as a hardy rootstock for grafting on hybrid cottons that produce superior cotton fibers; the ma'o is used for its disease and drought resistance. It is a great shrub for a coastal or dry forest planting. It is a handsome contrast when outplanted in a black cinder bed with its grayish leaves and bright yellow flowers. 'Ilima will enhance it even more if it is planted as a ground cover near by.

Entire Range: Hawaiian endemic

Wild Habitat: Arid, rocky, or clay coastal plains between sea level and 120 m elevation

Habit: Shrubs

Mature Height: 0.5–1.5 m tall

Stem/Trunk: Branching low woody shrub

Leaves: Leaves simple, pale green, heart-shaped with three to five palmate lobes; about 7 cm wide

Inflorescence/Flower: Solitary yellow flowers or a few on short cymes, three bracts, pedicel nectaries absent

Fruit: Three-celled capsules, leathery to woody, and about 1.5 cm long

Seed: Seeds about 5 mm long, covered with copious lint, reddish-brown in color (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the capsules when they are dry, brown, and splitting along their seams; keep them dry in a paper bag.
- Remove the fuzzy seeds from the capsules by hand.
- The seeds can be stored in desiccation for up to six years, or kept dry at room temperature or in the refrigerator.
- Soak the seeds in tap water for twenty-four hours; the seeds will initially float because of the cotton fibers.
- Use a mix made up of 3 parts perlite to 1 part potting mix (3:1) in shallow flats; cover the seeds with an additional inch of mix.
- Water the seeds in and keep them in a covered area; water them twice a week or when it is dry.

GERMINATION

- Germination can take three weeks to two months for all viable seeds to sprout.
- When four to six true leaves develop, it is time to transplant them into 2-inch pots using a well-draining mix.
- A mix made up of 3 parts black cinder to 1 part potting mix (3:1) works well with a small amount of 8-8-8 NPK fertilizer added.
- Repot them when the plants are twice as tall as the pots they are growing in.
- Move them into full sun to help harden them off and prepare them for outplanting.

CUTTINGS

- Take semi-hardwood to softwood cuttings following the protocols described.
- Use a mix of 3 parts perlite to 1 part vermiculite (3:1) or 1 part potting mix (3:1), applying rooting powder Nos. 1–3.
- The cuttings should be rooted in two to three months.
- Once they have rooted, transplant and handle them the same as described for the seedlings.

OUTPLANTING

- Your ma'o will be ready for outplanting when they are twice as tall as the 4–6-inch pots, or in about six months.
- Choose a site in full sun with well-draining soil; amend the soil as recommended.
- Water them in, then water in times of drought; keep them on the dry side; no irrigation systems are necessary as fungal spots (powdery mildew) develop on the leaves if the plant site stays too moist.
- Foliar feed them monthly or apply 8-8-8 NPK fertilizer every six months.

PESTS

- Ants and pests they farm can infest your ma'o plants; use a systemic pesticide and control them according to the protocols for ants.
- Whiteflies can occur on the underside of the leaves; apply systemic pesticides or spray with horticultural oils.
- Red spider mites can take up residence on the underside of the leaves; if they do, spray your plants with horticultural oil.
- Powdery mildew (fungi) appears as a whitish powder on the leaves and spreads rapidly when the plants are kept wet from irrigation and over watering. Prune off the affected leaves and dispose of them to prevent the spread of the fungi. Reduce watering and spray the affected foliage with a fungicide following the directions on the manufacturer's label.

MALVACEAE

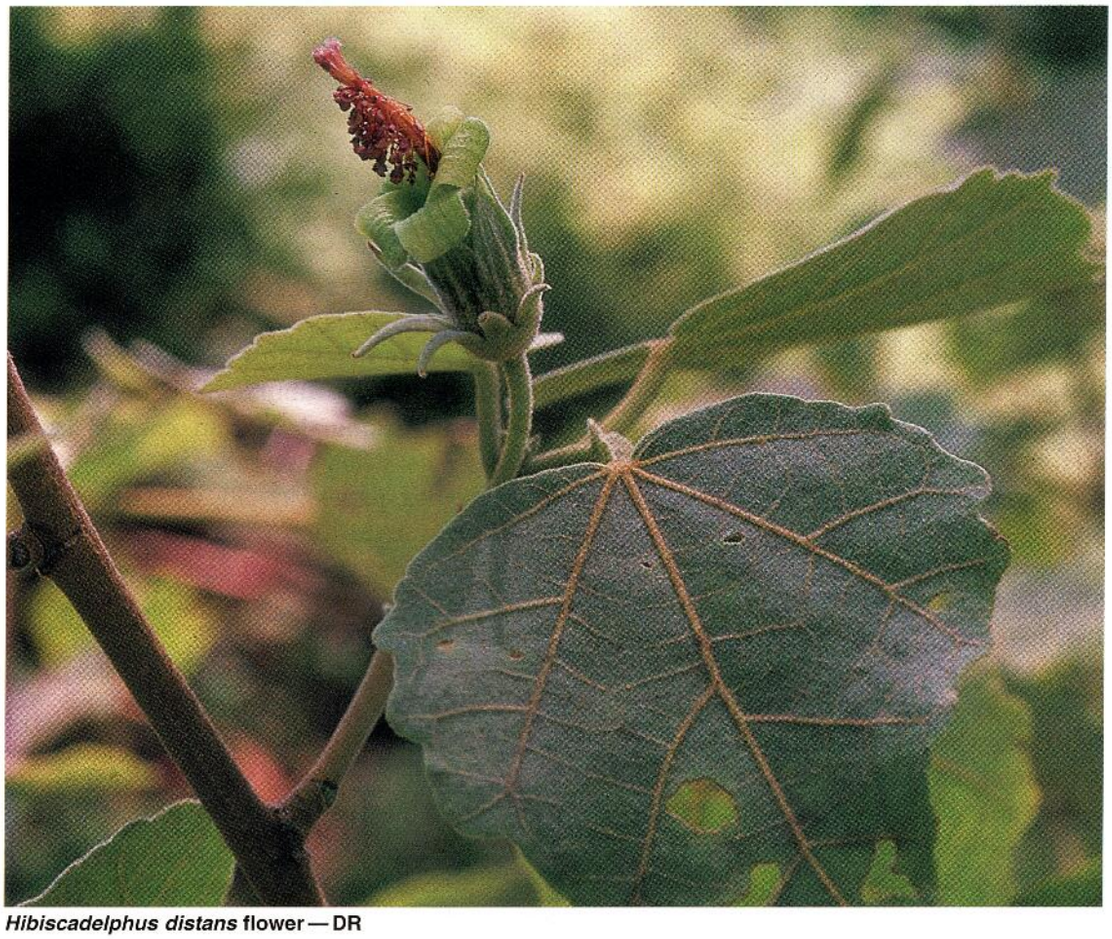
(MALLOW FAMILY)

M

GENUS: ***Hibiscadelphus***

HAWAIIAN NAME: **Hau kuahiwi**

SPECIES	STATUS	HAWAIIAN RANGE
H. bombycinus	Ex	end (H)
H. crucibracteatus	Ex	end (L)
H. distans	E	end (K)
H. giffardianus	Ex	end (H)
H. hualalaiensis	Ex	end (H)
H. stellatus	E	end (WM)
H. wilderianus	Ex	end (M)
H. woodii	Ex	end (K)



***Hibiscadelphus distans* flower — DR**

Partial Sun

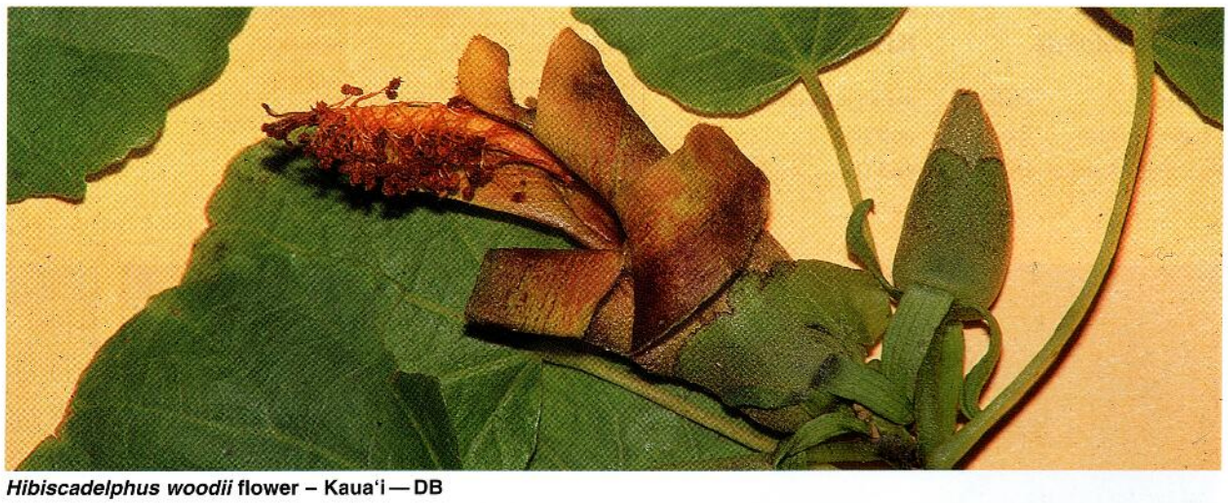
Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds, air-layering, and cuttings

GENERAL DESCRIPTION

Hibiscadelphus is a genus that only occurs in Hawai'i. These plants have a sad story to tell. They are all either extinct, endangered, or close to extinction in the wild, in large part because of invasive grazing animals and rats. Some do survive today in cultivation. Their name, *Hibiscadelphus*, means "brother to hibiscus." These true Hawaiian treasures co-evolved with their pollinators, endemic honey creepers (nectar-feeding birds) such as the 'i'iwi (*Vestiaria*). Their flowers have become narrow, curved tubes with large nectaries, which attract endemic curve-billed birds that can easily feed on the nectar (Carlquist 1980). The hau kuahiwi occur in dry to mesic forests as either small trees or shrubs, the leaves are roughly rounded but slightly lobed (*H. distans* and newly discovered *H. stellatus*, are believed to be the only two surviving species in this genus). Their curved flowers, which never fully open, are magenta, yellow, or green, depending on the species. Their woody, oval-shaped seed capsules, 1–2 inches long, split along the seams when they mature.



***Hibiscadelphus woodii* flower – Kaua'i — DB**

When dehiscing, they spill their brown, fuzzy seeds to the ground to germinate, but instead the seeds are usually eaten by introduced rats or insects. How sad it is that we cannot save these plants from their demise in the wild. The more threatened *H. woodii* discovered in 1991 was so isolated in the wild, only four individuals were known. Between 1995 and 1998, three were crushed by boulders and died, the last was found dead in 2011. *H. hualalaiensis* last known wild plant died in 1992, only twenty or so cultivated plants survive today in protected areas (NTBG). Unknown remaining plants that may exist are also threatened from their habitat loss (criminal). Inbreeding in small populations has caused hau kuahiwi to become weak and sometimes non-viable, making difficult to reproduce. Grafting may be the only hope for the rarer species, using the stronger *H. distans* for their rootstock.

Entire Range: Hawaiian endemic

Wild Habitat: Remnant dry forest; mesic forest

Habit: Woody shrubs to trees with a rounded crown

Mature Height: Up to 5 m tall

Stem/Trunk: Trunk 5–8 cm in diameter (30 cm *H. giffardianus*); smooth, grayish bark and prominent petiole scars on the young branches

Leaves: Leaves simple, with short leaf stalks (petioles), obscure stipules, and leaf blades rounded with angular shapes or shallowly lobed; leaf margins entire to shallowly toothed. Both leaf surfaces are covered with a fine surface of hairs.

Inflorescence/Flower: Solitary, perfect, borne near the branch ends, from the axils, flowers bilaterally symmetrical, flower parts in multiples of five, flowers tubular, the petals reflexed at opening, staminal column exerted when flower opens; ovary five-celled

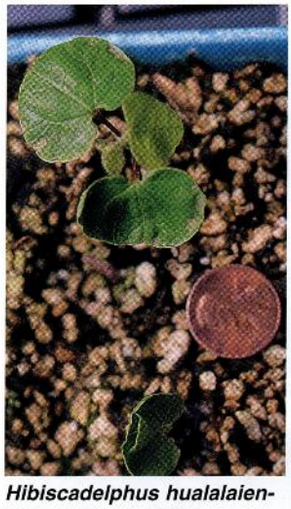
Fruit: Capsules, papery, ovoid, with five valves, dehiscent at maturity

Seed: Seeds kidney-shaped, about 5 mm long, and covered with a dense silky tomentum (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEED

- To propagate from seed, first collect the capsules when they are brown, mature, and starting to split open.
- Keep the seed capsules dry in a paper bag until separated.
- Remove the seeds by hand as soon as possible to avoid further insect damage (*H. distans*).
- The seeds can be stored at room temperature or refrigerated for a few years although it is best to start them fresh.
- Soak the seeds in hand-hot or tap water for twenty-four hours (*H. distans*), and one to two hours for the other species with larger seeds (*H. giffardianus*); the seeds will float because of the fuzz and the trapped air bubbles.
- Sow on leveled media made up of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1), then add ½ inch additional mix on top of the seeds.



Hibiscadelphus hualalaiensis seedling – NTBG nursery — PT



H. giffardianus — KLR

- Water them in, then water every other day, keep them more on the dry side, not soaking wet; do not allow the mix to dry out completely though.

GERMINATION

- Germination will take two weeks to three months if the seeds were soaked; if they were not soaked, it may take up to a year for all viable seeds to sprout.
- Wait until four to six true leaves develop, then transplant them into 3–4-inch pots.
- Use a well-draining mix, adding some black cinder works best; follow the recommended directions.
- Keep the potted seedlings in a shaded area; then repot them into larger pots when they are twice as tall as their pots.
- Foliar feed them monthly or add small amounts of 8-8-8 NPK fertilizer.

AIR LAYERING

- Follow the protocols for air layering as described.
- Air layering will be successful if the source plants are healthy and growing strong; use rooting powder No. 8.

CUTTINGS

- Semi-hardwood to hardwood cuttings will work if the plants are growing vigorously and healthily. Follow the protocols described for *Hibiscus*.
- If the plants are sick and weak, do not attempt cuttings. You will be wasting the plant's material, and your time.
- Taking the cuttings at the wrong time can also weaken the parent plant further. The cool morning hours in the spring months are the best time.
- A mist system works best for these endangered cuttings.

OUTPLANTING

- Your plants will be ready for outplanting in about a year, when they have outgrown a 1-gallon pot.
- To prevent poor root systems, do not allow the plants to become root-bound in the pots at any time.
- Choose a site in partial sun and with well-draining soil; amend the soil as recommended.
- Soil that does not drain well will kill the plant eventually.
- Protect them from strong winds, and provide support if needed.
- Plant *Hibiscadelphus* with other native plants, ground covers, subshrubs, and trees.
- Foliar feed them monthly, or apply small amounts of 8-8-8 NPK fertilizer every six months.

PESTS

- Chinese rose beetles eat the leaves, reducing photosynthesis and stressing the plant. Apply a systemic pesticide as recommended.
- Ants and their associated pests that they farm can infest your plants; use a systemic pesticide and control them according to the protocols for ants.
- Whiteflies and white hibiscus scale can infest your *Hibiscadelphus*; if they do, wash them off with a strong water spray, or spray with horticultural oil.
- Black twig borers lay their eggs into the pith of the stem. The offspring feeds on the pith after hatching, killing the plant from the hole up. Trim off the affected portion and the plant may grow back. Use systemic pesticides as recommended.

M

MALVACEAE
(MALLOW FAMILY)

GENUS:
Hibiscus

HAWAIIAN NAME:
Aloalo

There are five endemic species of *Hibiscus* and nine endemic subspecies.

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds, air-layering, grafting, & cuttings

[1]Three previously recognized *Hibiscus* are included here as synonyms under the species they are currently classified as. Their morphological characteristics remain distinct from one another and are worth keeping separate.

HAWAIIAN NAME:
Hau hele; koki'o kea; pāmakani

SPECIES	STATUS	HAWAIIAN RANGE/DESCRIPTION
H. arnottianus subsp. *arnottianus*		end (O) white petals, red staminal column
H. arnottianus subsp. *immaculatus*	—	end (Mo) white on white
H. arnottianus subsp. *punaluuensis*	—	end (O) white flowers with smooth green leaves, trees about 10–30 ft. tall, found in mesic to wet forests

HAWAIIAN NAME:
Ma'o hau hele

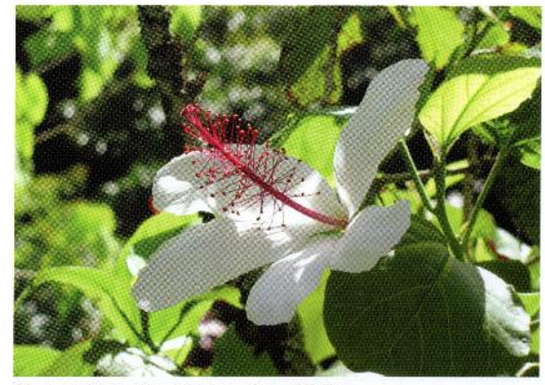
SPECIES	STATUS	HAWAIIAN RANGE/DESCRIPTION
H. brackenridgei subsp. *brackenridgei*	E	end (Mo, L, M, H)
H. brackenridgei subsp. *mokuleianus*	E	end (K, O) yellow flowers, rough grayish-green leaves, 5–6 ft tall, found in dry forests
H. brackenridgei ssp. *molokaianus*	E	end (Mo)

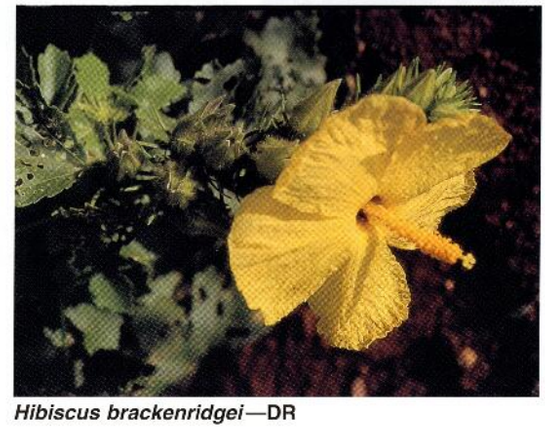
COMMON NAME:
Clay's Hibiscus

SPECIES	STATUS	HAWAIIAN RANGE/DESCRIPTION
H. clayi	E	end (K) small dark red flowers, small, narrow, shiny oval leaves, 20 feet tall, found in dry forests, eastern Kaua'i
[1]*H. newhousei* [syn.]	—	—

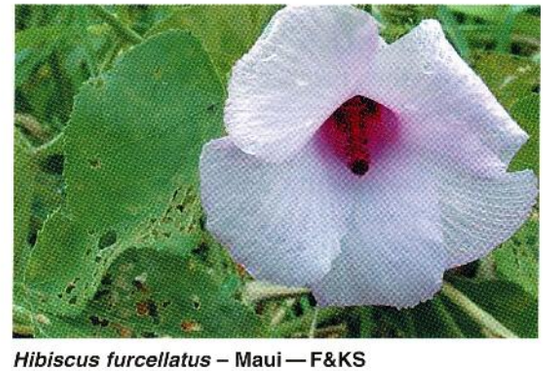
HAWAIIAN NAMES:
'Akiohala; 'akiahala; hau hele; hau hele wai

SPECIES	STATUS	HAWAIIAN RANGE/DESCRIPTION
H. furcellatus	—	ind (K, O, M, H) small shrub 4 to 6 feet tall, pink to rose-colored flowers, coarse heart shaped or lobed leaves, plant covered with bristly hairs; found in wet, marshy areas in Hawai'i


***H. a.* subsp. *punaluuensis*—KLR**


***Hibiscus brackenridgei*—DR**


***H. newhousei* flower & seeds —KLR**


***Hibiscus furcellatus* – Maui — F&KS**



Yellow ***H. k. saintjohnianus*** **– KLR**



H. kahilii **— KLR**



H. kokio **– kipu kai — KLR**



4 petaled *H. saintjohnianus* – KLR



(left) *H.* ssp. *immaculatus*, (top right) *H. waimeae*, (bottom) *H.* ssp. *hannerae* — KLR

HAWAIIAN NAMES:

Koki'o; koki'o 'ula; mākū

SPECIES	STATUS	HAWAIIAN RANGE/DESCRIPTION
H. kokio subsp. *kokio*	R	end (K, O, Mo, M, H?) small tree with small leaves and long, narrow, red petals
[1]*H. kokio* var. *pukoonis* [syn.]	—	(Mo) tall straight tree with short-petaled red flowers, in dry to wet forests
[1]*H. kahilii* [syn.]	—	(K) small tree in the wet forest
H. kokio subsp. *saintjohnianus*	R	end (K) tall straight, small tree with dark orange, yellow-orange, pinkish, and orange-red flowers, found in dry to mesic forests.

HAWAIIAN NAMES:

Koki'o ke'oke'o; koki'o kea

SPECIES	STATUS	HAWAIIAN RANGE/DESCRIPTION
H. waimeae subsp. *hannerae*	E	end (K) small white fragrant flowers, petals reflexed, larger rounded leaves, smaller rounded shrub, wet forests, occurring in north western valleys of Kaua'i
H. waimeae subsp. *waimeae*	R	end (K) large white fragrant flowers ; downy, round, toothed leaves, tall straight tree, occurring in diverse mesic forests

GENERAL DESCRIPTION

The endemic *Hibiscus* species of the Hawaiian Islands are believed to be the result of four independent colonization events. They occur in dry to wet forests on all the main islands as shrubs to tall trees. Flowers can be white, yellow, orange, or red, depending on the species. *Hibiscus* is the easiest genus to grow and maintain in the landscape. It is readily grown from seeds, cuttings, air layering, and/or grafting. The uniquely beautiful flowers of the *Hibiscus* make this one of my favorite plants to propagate and grow.

Range: Hawaiian endemic

Wild Habitat: Dry, mesic to wet forests

Habit: Subshrubs, shrubs to trees

Mature Height: 1–10 m in height

Stem/Trunk: Woody and branching with smooth to pubescent (hairy) stems

Leaves: Leaves are simple, with leaf stalks, stipules, leaves usually not lobed but some species with palmately lobed leaves; margins entire to toothed; leaf surfaces smooth and glossy to soft and covered with a surface of fine hairs

Inflorescence/Flower: Flowers solitary, growing from the leaf axils or at the ends of the branches, flower parts in multiples of five, staminal column, five-celled ovary, petals with a wide array of colors including white, yellow, pink, red, and orange. Some species of Hawaiian *Hibiscus* flowers produce a fragrance

Fruit: A capsule with locular chambers, each splitting open at maturity

Seed: Seeds angular-kidney-shaped and either smooth or covered with hairs (pubescent) (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

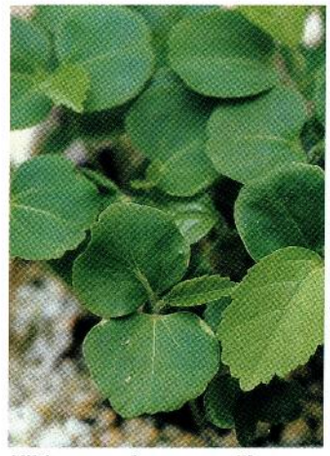
- To propagate from seeds, first collect the brown seed capsules when they are mature and starting to split open.
- Keep them dry in a paper bag until cleaning. Prepare them as soon as possible to prevent any insect damage, such as from seed weevils.
- Seeds can be stored at room temperature, refrigerated, or in a desiccation chamber, but viability is higher if you start with fresh seeds.
- Soak the small fuzzy seeds in tap water for twelve to twenty-four hours; the seeds should sink after the soaking time.
- Sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), cover the seeds with ½ inch of additional mix, then water them in.
- Keep them moist in a covered area; watch for slugs, which will eat the seedlings.

GERMINATION

- It can take from five days to three months for all viable soaked seeds to germinate.



***Hibiscus clayi* seeds and capsules – NTBG — MC**



***Hibiscus waimeae* seedlings – NTBG nursery — KLR**

- Wait until at least four true leaves develop before transplanting, then transplant into 2–4-inch pots, depending on the size of the root balls.
- Keep the seedlings in a shaded area, slowly moving them into a sunnier area to harden them off.
- Repot into larger pots when they become twice as tall as pots they are growing in; it is important that the plants do not become root-bound at any time. Root-bound plants can result in poor root systems that will eventually kill the plants.
- Foliar feed them monthly and add small amounts of 8-8-8 NPK fertilizer every three to six months.

CUTTINGS

- Follow the directions for all the types of cuttings; all types work with *Hibiscus*. My preference is to use hardwood cuttings with rooting powder Nos. 3–8.
- Your cuttings will root in about three to five months depending on the health of the parent plant.
- Handle and care for the cuttings the same as described for the seedlings.

AIR LAYERING

- Follow the directions for air layering and handling; use rooting powder Nos. 8–30, as all work well.
- Roots should develop in about three to five months.

GRAFTING

- Grafting is a specialty technique in itself. If you are unfamiliar with grafting, refer to the many books and resources available on grafting techniques first. Here I will describe how

to apply these techniques to the Hawaiian *Hibiscus* species.

- First, prepare your rootstock by growing *Hibiscus rosa-sinensis* (common red hibiscus) for the best rootstock. This can be grown from seed or hardwood cuttings. Keep the rootstocks from becoming root-bound by repotting as they grow; this will reduce or eliminate damaging the root system. Do not graft onto a newly repotted rootstock because it is still weak.
- Native *Hibiscus* can also be used for rootstock. For example, *H. waimeae* subsp. *hannerae* can be grafted onto *H. waimeae* subsp. *waimeae* as the rootstock. These can then both be allowed to grow out and display both blossoms. Another extraordinary result can be obtained from grafting all of the different colors of *Hibiscus kokio* subsp. *saintjohnianus* flowers onto one rootstock.
- Follow the directions for grafting as described in the many books on the subject.
- It can take three to five months for grafts to callus over.
- Repot them when the plants are twice as tall as the pots they are growing in.
- Foliar feed them monthly and apply small amounts of 8-8-8 NPK fertilizer.

OUTPLANTING

- It will be six months to a year before your *Hibiscus* is strong enough for outplanting.
- Choose a site in partial to full sun and out of strong winds.
- If the roots are circling around in the pot, undo them and carefully try to get them to grow straight down into the planting hole. If the circling roots are not corrected, they will grow around the shrub, eventually strangling the plant and killing it within a few years.
- Plant *Hibiscus* with other plants, ground covers, and subshrubs.
- Amend the site to create a well-draining soil; fertilize the area as recommended.
- Water in the plants, then water them weekly depending on the rainfall, until they are well established and are growing healthily.
- Foliar feed them every two months and add small amounts of 8-8-8 or 14-14-14 NPK fertilizer amended into the surrounding soil.



***H. brackenridgei* – scale—KLR**

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Hibiscus* plants; use a systemic pesticide and control them according to the protocols for ants.
- Chinese rose beetles eat the leaves, reducing photosynthesis and stressing the plant; apply a systemic pesticide as recommended.
- Whiteflies and snow scale can infest your *Hibiscus*; if they do, wash them off with a strong water spray or spray with horticultural oil.
- Red spider mites can take up residence on the underside of the leaves. If they do, spray your plants with horticultural oil.
- Hibiscus erineum mite control as recommended, in Pest Management.

MALVACEAE

(MALLOW FAMILY)

GENUS:

Kokia

HAWAIIAN NAMES:

Koki'o; hau hele 'ula

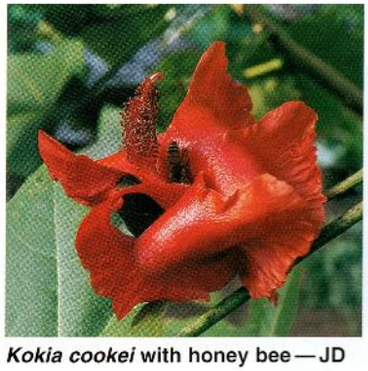
SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
K. cookei	Ex	end (Mo) arid
K. drynarioides	E	end (H) dry forests
K. kauaiensis	V	end (K) diverse mesic forests
K. lanceolate	Ex	end (O) diverse mesic forests

Full Sun – Partial Sun

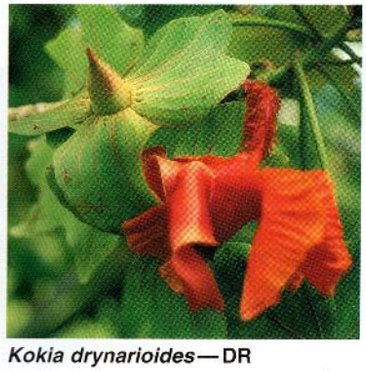
Range
Hawaiian Endemic

Description
tree

Propagation
seeds and air-layering



***Kokia cookei* with honey bee — JD**



***Kokia drynarioides* — DR**



***Kokia kauaiensis* — KLR**

GENERAL DESCRIPTION

Kokia is only known in the Hawaiian Archipelago. This endemic genus of small trees, 12–30 feet tall, are either extinct or highly at risk of extinction in the wild due to introduced grazing animals and loss of habitat. *K. lanceolate* became extinct in 1880s, most likely due to grazing pressure from cattle and goat ranching. We should work together to protect and preserve these precious gems of Hawai'i, both in the wild and in cultivation. The leaves are leathery, heart-shaped, with three to seven shallow lobes that cluster at the branch ends. They drop their leaves (deciduous) during the dry dormant seasons to conserve energy. Nothing can compare to the beauty of the *Kokia*'s large, brilliant flowers, about three inches long, and scarlet to brick red. They have slightly twisted petals that sit on a large broad bract. Oval, woody capsules also sit on these broad bracts (like a cup and saucer), containing large, furry, brown seeds that germinate fast when they are scarified. Hawaiians once dyed fishnets with the reddish-brown juice extracted from the bark. *Kokia cookei* is extinct in the wild (fire 1978) and has been successfully grafted on to *K. drynarioides* and *K. kauaiensis* as rootstocks. Top grafting worked the best for me; it resulted in nicer growth, and the plants grew straight up. These beautiful trees have great potential as landscape plants. *K. kauaiensis* (45+ individuals remaining in the wild) and *K. drynarioides* produce an abundance of viable seeds and are easy to germinate and maintain in the landscape.

Entire Range: Hawaiian endemic genus

Wild Habitat: Dry forest, lava fields, diverse mesic forests

Habit: Small branching trees

Mature Height: 3–10 m in height

Stem/Trunk: Woody, branching, prominent petiole scars, some pubescence (velvety)

Leaves: Deciduous, leaves simple, lobed palmately in fives, sevens, or nines; with shallow, angulate lobes. Leaf upper surfaces smooth, undersides fuzzy (densely pubescent), leaf margins entire, leaf stalks about as long as the leaf blades.

Inflorescence/Flower: Flowers solitary, clustered near the branch ends and from the leaf axils, cylindrical calyx two to five lobed, corolla bilaterally symmetrical, flower parts in multiples of five, petals brilliant red, scarlet, or brick-red. Flower petals reflexed above

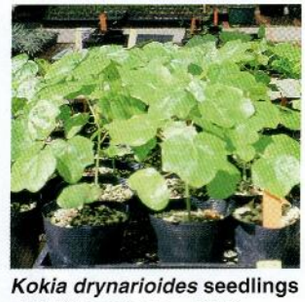
anthesis, and twisted at base, and staminal column exserted and curved.

Fruit: Woody with locular dehiscent capsules

Seed: Seeds 10–15 mm long, densely covered with reddish wool (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Kokia drynarioides* seedlings – NTBG nursery — KLR**

- To propagate from seeds, first collect the ripe capsules when they are dry, brown, and starting to split open.
- Keep the capsules dry in a paper bag.
- Separate the seeds from the capsules by hand.
- The seeds can be stored in a freezer, refrigerator, or desiccation chamber, or at room temperature for three or more years.
- To properly scarify the seeds, remove some of the fuzz to reveal the smooth seed coat; nick a small area with clippers, and be careful not to damage the embryo by nicking in too deep.
- Do not soak the seeds after scarifying them; if this is done, the embryos will drown and the seeds will rot and die.
- Sow on a leveled media of 3 parts perlite to 1 part potting mix (3:1), and then cover the seeds with an additional 1-inch of mix.
- Water the seeds in, then water every two days and keep them in a covered area.

GERMINATION

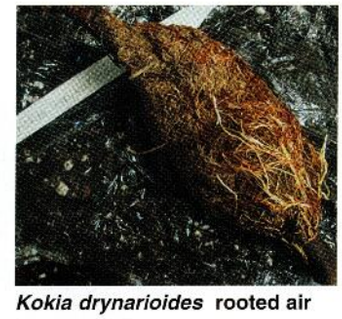
- It can take between ten days and one month for all of the scarified viable seeds to germinate.
- Wait until two to four true leaves develop, then transplant them into 4–5-inch pots with cindery soil.
- Keep the seedlings in the shade; repot them when the seedlings outgrow their pots, which can be about four to five months.
- Move them into an area with more sun to harden them off and help them tolerate outplanting.

CUTTINGS

- Cuttings do not take readily; I recommend propagation by seeds for the best results.

AIR LAYERING

- Follow the protocols for air layering and handling (p.25-27); the rooting powders that work well are Nos. 8, 16, and 30.



***Kokia drynarioides* rooted air layer — KLR**

OUTPLANTING

- Your *Kokia* will be ready for outplanting in about one year, when they have outgrown their 1–2-gallon pots.
- It is important that these plants do not become root-bound at any time in their development; this can result in a poor root system.
- Choose a site in partial to full sun with well-draining soil, which can be amended as recommended.
- Choose a planting site out of strong, direct winds, and water them in. Then water only when they are dry; monitor them closely.
- Foliar feed the *Kokia* monthly, and apply small amounts of 8-8-8 NPK fertilizer every three to six months. Work the fertilizer into the soil; do not apply it against the base of the tree.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Kokia* plants; use a systemic pesticide and control them according to the protocols for ants.
- Chinese rose beetles eat the leaves, reducing photosynthesis and stressing the plant; set up a solar light near by or apply a light solution of systemic pesticide as recommended.
- Whiteflies can infest your *Kokia* leaves; if they do, wash them off with a strong water spray or spray with horticultural oil.
- Red spider mites can take up residence on the underside of the leaves; if they do, spray your plants with horticultural oil.
- Rats are known to eat the seeds and seedlings of *Kokia*; set rat traps to control them.
- Keep weeds away from the base of the tree (carefully weeding by hand) to avoid weed-eater damage.

M

MALVACEAE
(MALLOW FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Sida	**'Ilima**	*S. fallax*	—	ind (Kl, Le, HI)

Full Sun

Range
Hawaiian Indigenous

Description
ground cover to shrub

Propagation
seeds



***Sida fallax*, 'ilima papa — CC**

GENERAL DESCRIPTION

'Ilima grow as low, prostrate shrubs or small, erect shrubs up to 4 feet in height. They occur on dry coastal to diverse mesic forests up to 2,000 feet elevation. 'Ilima is by far the simplest genus of this family to grow and maintain in drier landscapes. Plants that grow in coastal habitats have lower growth habits and smaller, grayer leaves to reflect the harsh sun and tolerate the ocean spray. The double flower varieties are strung into leis (the lei of O'ahu), and come in an array of colors from yellow to dull red. The blossoms can be 1 inch across, and develops near the branch tips. Small brown, star-shaped capsules contain about five tiny fuzzy brown seeds that germinate easily becoming weedy in your garden, which is a good thing. 'Ilima does not root into the ground from its nodes like the *Jacquemontia*. The two species make great companions in the garden as ground covers. Hawaiians used the flowers and roots medicinally (Neal 1965).

Entire Range: Indigenous to Midway Atoll, Nihoa, and all main Hawaiian Islands.
Wild Habitat: Coastal dry habitats
Habit: Prostrate spreading to erect branching shrub
Mature Height: Ground level to 4 feet (1.2 m) in height
Stem/Trunk: Stems herbaceous, semi-woody to woody, smooth to fuzzy (covered with hairs)



***Sida fallax*, lei 'ilima — KJ**

Leaves: Leaves simple, heart-shaped, usually unlobed, margins with teeth, smooth or velvety and silvery due to covering of hairs, short leaf stalks, and stipules present

Inflorescence/Flower: Solitary, emerging from leaf axils or at the branch ends, golden yellow to orange-yellow, flower parts in multiples of five, and staminal column yellow

Fruit: Fruit a schizocarp, star-shaped, with six to nine locular chambers (mericarp) pale brown to black, about 3–4 mm long

Seed: Seeds brown or black, 1–2 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seeds, first collect the mature dry star-shaped capsules; keep them dry in a paper bag until cleaned.
- Separate the seeds from the capsules as recommended for small dry seeds.
- The seeds can be stored using any of the methods discussed.
- Soak the seeds in hand-hot or tap water for twenty-four hours.
- Surface sow on dry media of 3 parts perlite to 1 part potting mix (3:1) in a shallow flat; water the seeds in.
- Keep them in a covered area to protect them from too much moisture.

GERMINATION

- Your 'ilima will germinate in about two weeks to two months for all viable seeds to sprout.
- Wait until the seedlings have two to four true leaves before transplanting into 2–4 inch pots.
- Use a well-draining mix with small amounts of 8-8-8 NPK fertilizer.
- Repot into larger pots and add new media every two to three months (fast-growing).
- Foliar feed them monthly; keep them more on the dry side.
- Move them into full sun to harden them off and prepare them for outplanting.

OUTPLANTING

- Your 'ilima will be ready to outplant when they have outgrown a 4–6-inch pot, which can take about six months.
- Choose a site with well-draining soil; it can be cindery or sandy, and it should be in full sun.
- Water your plants in, and then only water in times of prolonged drought.
- Foliar feed your 'ilima monthly on average for healthier growth.
- An ideal planting can be done by creating a cinder mound with the contrasting 'ilima's gray foliage and yellow flowers; this makes a very attractive landscape.
- Plants can tolerate trimming if needed.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your 'ilima plants and become terrible pests; use a systemic pesticide and control them according to the protocols for ants.
- Red spider mites can take up residence on the underside of the leaves. If they do, spray your plants with horticultural oil.
- Rust spots or small raised orange spots can appear on the underside of the leaves if the plant receives too much shade and moisture. To treat, reduce both moisture and shade.

M

MENISPERMACEAE

(MOONSEED FAMILY)

GENUS:

Cocculus

HAWAIIAN NAMES:

Huehue; hue; hue ʻie; ʻinalua

SPECIES	STATUS	HAWAIIAN RANGE
C. orbiculatus (syn: *trilobus*)	—	ind (HI exc. Ka)

Full Sun – Partial Sun

Range
Indigenous

Description
sprawling vine

Propagation
seeds



***Cocculus orbiculatus* – Hawaiʻi — KRW**

GENERAL DESCRIPTION

The roots of this climbing, sprawling vine have been reported as poisonous (toxic) (Carlquist 1980). Occurs in dry to mesic areas, on grasslands, and old lava flows. The leaves are alternate, oval, 2–3 inches long, and covered with fine short hairs. Tiny, yellowish-white, unisexual flowers form in whorled clusters; male and female flowers are borne on separate plants. Small round green drupes (fruits) later develop in clusters along the thin stems, turning dark blue with maturity. This is an easy vine to grow and maintain in the landscape.

Entire Range: Indigenous to southeast Asia, Himalayas, Malaysia, and parts of the Pacific; Hawaiʻi (HI exc. Ka)

Wild Habitat: Open areas, grasslands, talus slopes, lava, mesic to dry forests 2–1,400 m elevation

Habit: Sprawling vine

Mature Height: Not applicable

Stem/Trunk: Herbaceous, sparsely to densely covered with fine, short hairs

Leaves: Leaves are variable, alternate, margins entire, oval to lanceolate, about 10 cm long by about 4 cm wide; 3-nerved parallel

Inflorescence/Flower: Flowers are unisexual (dioecious), flower parts in multiples of three, bilaterally symmetrical, small, yellowish-white flowers, borne at the ends and out of the leaf axils in simple or compound cymes about 6 cm long; peduncles about 12 mm long, se-pals six to nine, in double or triple whorls of three, six petals, six stamens about 1 mm long (male flower); six ovaries in female flowers

Fruit: Fruit is a dark blue drupe about 5 mm in diameter and smooth

Seed: Seeds small and curved (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect the fruit (drupes) when they are dark blue in color; keep them moist in plastic bag until cleaned.
- Separate the seeds from the pulp as recommended for small pulpy seeds.
- Start the seeds fresh by first soaking them in tap water for 1 hour; the viable seeds should sink.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1); cover the seeds with an additional ½ inch of the mix.
- Keep the shallow seed flats in a covered area and water them every other day.

GERMINATION

- All viable seeds should germinate in about one to four months.
- They will be ready for transplanting when at least four true leaves develop; then transplant them into 2-4-inch pots of well-draining mix.
- Repot them in about six months time, into larger pots and use new cindery media.
- Move them into full sun to harden them off to prepare them for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in six months to a year; you will know they are ready when they have outgrown a 6-inch or 1-gallon pot.
- Choose a site in full to partial sun with cindery, well-draining soil.
- Let this thin vine grow up a tree, fence, or trellis, or onto a cinder mound sprawling along the ground, has potential to become weedy.
- Water in the plants, then water when it is dry until new healthy growth develops; after that, only water in times of prolonged drought.
- Foliar feed your plants every three months and apply 8-8-8 NPK fertilizer every six to eight months.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your huehue plants; use a systemic pesticide and control them according to the protocols for ants.

M

MORACEAE
(MULBERRY FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Streblus	**A'ia'i**	*S. pendulinus*	—	ind (HI exc. Ni, Ka)



***S. pendulinus*—JO**

Full Sun – Partial Sun

Range
Indigenous

Description
shrub to tree

Propagation
seeds

GENERAL DESCRIPTION

A'ia'i is a small, slender hardwood tree or large shrub with few branches containing watery-milky sap. The leaves are alternate, papery and narrow, darker green on the upper surface, pale green on lower surface. The flowers are unisexual with the male and female flowers on separate plants. The flower clusters form near the branch ends and from the leaf axils. The male flowers are white and turn purple with age; the female flowers are green and develop on long spikes. There are four to five brownish-purple, slightly pulpy fruit (drupes) per spike. They occur in mesic forests and sometimes on the drier portions of wet forests.

Entire Range: Indigenous to New Guinea, Micronesia, Norfolk Island, eastern Australia, New Hebrides, Fiji, Rapa, and, in Hawai'i, all of the main islands except Ni'ihau and Kaho'olawe

Wild Habitat: Mesic, dry or wet forests, 300–1,680 m elevations

Habit: Shrub or small tree

Mature Height: 2–8 m height

Stem/Trunk: The bark is gray; the stems have a milky, watery sap, which is not abundant

Leaves: Leaves are simple, alternate, 2-ranked, oblong-lance-shaped, leaf margins are toothed; the upper leaf surfaces are dark green, the underside paler; leaves are papery; leaf stalks up to 1 cm long

Inflorescence/Flower: Flowers unisexual and dioecious, whitish-green, male flowers occur on spikes about 9 cm long with four stamens, four sepals; female flowers on spikes about 1 cm long, flower stalks 1–3 mm long, sepals ovate

Fruit: Fruit is a drupe and there are about four to five fruits per spike; they are brownish-purple when ripe, shiny, and are compressed laterally about 10 mm long

Seed: The seeds are about 5 mm long and asymmetrical in shape (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, collect the drupes (fruit) when they are mature and purplish in color; keep them moist in a plastic bag until cleaned.
- Separate the pulp from the seeds as recommended for small pulpy seeds.
- Soak the seeds in tap water for one to two hours; the viable seeds should sink.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1) or onto a fine cinder; cover the seeds with ½ inch more of the mix.
- Water them in, then water every other day keeping them on the dry side.
- Keep them in a protected, covered area from heavy rain & wind.

GERMINATION

- All viable seeds of your a'ia'i will germinate in two to four months; they have low viability.
- Wait until four to six true leaves develop, then transplant them into 3–4-inch pots.
- Use a well-draining cindery soil with small amounts of 8-8-8 NPK fertilizer.
- Repot the seedlings when the trees are twice as tall as their pots.
- Move them into more sun to help prepare them for outplanting by hardening them off.
- Foliar feed them monthly.

OUTPLANTING

- Your plants will be ready for outplanting in about a year, when the plants have outgrown a 1-gallon pot.
- Choose a site with full to partial sun and with well-draining soil; amend the ground as recommended.
- Plant your trees out of strong winds; fertilize every three to six months with 8-8-8 NPK fertilizer.
- Monitor your plants for good soil drainage; too much moisture is not recommended.
- After the trees are established, water only in times of prolonged drought.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your a'ia'i plants; use a systemic pesticide and control them according to the protocols for ants.

M

MYOPORACEAE

(MYOPORUM FAMILY)

GENUS:

Myoporum

HAWAIIAN NAMES:

Naio; naeo; naieo

COMMON NAME:

Bastard sandalwood

SPECIES	STATUS	HAWAIIAN RANGE
M. sandwicense	—	ind (HI exc. Ka)
M. stellatum	—	end (O)

Full Sun

Range
Endemic and Indigenous

Description
low shrub to large tree

Propagation
seeds



Myoporum stellantum – O'ahu — SP

GENERAL DESCRIPTION

The niao grows as a many-branched, low shrub to large tree, depending on its habitat. It occurs most frequently in dry forests and growing near sea level. The leaves are alternate, 2–6 inches long, and dark green, clustering at branch ends. Flowers are small, pink to white, and five-parted. They cluster along the twigs, as do the small, rounded, whitish to purplish fruits that contain one corky, ribbed seed. The Hawaiians used the larger trunks and branches as hale (house) posts and smaller materials serve as thatching poles (Abbott 1992). It is called "bastard sandalwood" because of the strong hardwood, dark yellow-green and slight sandalwood scent. During the days of the sandalwood trade in the Hawaiian Islands, the naio was substituted for sandalwood when the prized wood was depleted from the forests. Naio is a very easy plant to grow and maintain in your garden and complements plantings of 'ilima (*Sida fallax*), pā'ū-o-hi'iaka (*Jacquemontia ovalifolia*) or 'ākia (*Wikstroemia uva-ursi*) grown underneath as ground covers.

Entire Range: Indigenous to Mangaia, Cook Islands, and all of the main Hawaiian Islands except Kaho'olawe

Wild Habitat: Strand vegetation, dry forest, lava, mesic to wet forest, subalpine forests, from sea level to 2,380 m

Habit: Shrub, branching small trees

Mature Height: 1–15 m height

Stem/Trunk: Stems erect to prostrate, smooth

Leaves: Leaves are simple, alternate, and variable in shape from elliptic to lance-shaped, about 15 cm long to about 3 cm wide, leaves can be fleshy, papery, and leathery, stipules absent. Leaves have entire margins, smooth surfaces; leaf stalks are about 2 cm long and are usually winged.

Inflorescence/Flower: Flowers perfect, irregular, axillary, usually between two and ten per cyme, calyx five-lobed, glandular, corolla white, and white with purplish-pink, bell-shaped

Fruit: Fruit a drupe, greenish-white to pinkish-purple, and ribbed when dry

Seed: Seeds spindle-shaped, one per cell, and papery when dry, about 2 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



Myoporum sandwicense seeds — F&KS

- To propagate by seeds, first collect the fruits when they are soft and whitish or purplish in color, and keep them moist in a plastic bag.
- Separate the seeds from the pulp as recommended for medium pulpy seeds.
- Seeds can be stored for up to six years but are more viable when they are started fresh.
- Soak seeds in tap water for five days or in hand-hot water for thirty-six hours; the seeds will float at first, and then will sink if they are viable.
- Sow onto a leveled mix of 3 parts perlite to 1 part potting mix (3:1); then cover the seeds with ½ inch of additional mix, then water them in.
- Keep the flats in a covered area, moving into partial sun when the naio start to sprout. Do not allow the media to dry out at this time.
- Water every other day, foliar feed sprouted seedlings monthly.

GERMINATION



Myoporum sandwicense seedlings — PT

- Germination can take from one month for seeds soaked for five days, and up to six months for all other viable seeds to sprout.
- Wait until four to six true leaves develop, then transplant into 2–4-inch pots with well-draining mix and small amounts of 8-8-8 NPK fertilizer. Foliar feed them monthly.
- Repot them into larger pots and add new media every four to six months.
- Move into full sun to help prepare them for outplanting by hardening them off.

OUTPLANTING

- Your naio will be ready for outplanting in six months to a year, when they have outgrown a 1–2-gallon pot.
- Choose a site in full sun which is also out of direct strong winds; if the site is windy, provide support for the plants.
- Amend the planting hole and soil to create a well-draining site by adding cinder or other amendments as recommended in soil amendments.
- Water in your plants, then water monthly and monitor for proper drainage and moisture, watering in times of prolonged drought.
- Use small amounts of 8-8-8 or 14-14-14 NPK fertilizers, foliar feed your naio every couple of months.
- Naio are easy trees to maintain; they have little to no problems with adapting to different environments, providing the soil is well-draining.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your naio plants; use a systemic pesticide and control them according to the protocols for ants.
- Poor drainage and damp soil will eventually kill this plant, which loves arid conditions.

MYRSINACEAE

(MYRSINE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Embelia	**Kilioe**	*E. pacifica*	—	end (HI exc. Ni, Ka)

Partial Sun

Range
Hawaiian Endemic

Description
woody vine to shrub

Propagation
seeds



***Embelia pacifica* flowering – Maui — KRW**

GENERAL DESCRIPTION

Kilioe is a climbing woody vine, or when it is young, a straggling shrub, with alternate, oval-shaped leaves networked throughout with red veins. Some plants have a reddish pubescence (hairs) on the glands, inflorescence (flower spikes), and new growth. Small greenish flowers are in narrow clusters at the leaf axils, and are dioecious (having male and female flowers on separate plants). The round, slightly flattened fruits are drupes, dark purple and fleshy when mature. Kilioe occurs scattered in mesic and, occasionally, in wet forests.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic to wet forests from 125–1,650 m

Habit: Woody vines (mature) or scandent shrubs (juveniles)

Mature Height: Not applicable

Stem/Trunk: Branches spreading and covered with prominent slightly raised lenticels (area in the corky tissue of the bark that allows for exchange of gases between the plant and the atmosphere)



***E. pacifica* habitat – Maui —F&KS**

Leaves: Leaves, simple, alternate, pinnately veined, dotted with small, glandular pits, leaves thin, papery and oval to elliptic about 12 cm long by about 8 cm wide. Leaves with prominent network of veins and midrib often reddish; leaf stalks about 7 mm long

Inflorescence/Flower: Flowers unisexual and dioecious, in racemose inflorescences borne from the leaf axils, about 35 mm long. Flower calyx four to five lobed, petals four to five, greenish, densely covered with small glandular pits, distinct and about 3–4 mm long, stamens (male flowers) slightly more than half as long as the petals; ovary (female) with three ovules, stigma is head-like

Fruit: Fruit a globose drupe, dark purple, and about 8 mm in diameter

Seed: Seed small with a hard but brittle endocarp (Wagner et al. 1990)

PROPAGATION AND CULTIVATION SEED

- To propagate by seeds, first collect the fruits (drupes) when they are purple and soft; keep them moist in a plastic bag until cleaning.
- Clean the seeds as recommended for small pulpy seeds.
- Soak the seeds for twenty-four hours in tap water or hand-hot water, twelve hours; all viable seeds should sink.
- Sow them in a mix of 3 parts perlite to 1 part potting mix (3:1) and cover the seeds with ½ inch of additional mix.
- Water them in, then water every other day; keep them in a shaded, covered area.

GERMINATION

- Germination will occur in one to three months; wait until two to four true leaves develop.
- Then transplant them into 2- 4 inch pots of well-draining mix, and keep them in the shade.
- Foliar feed them monthly, watering every other day.
- Repot your plants into larger pots and add new media every six months; add small amounts of 8-8-8 NPK fertilizer.
- Move to partial sun to harden off for outplanting, or keep in a pot.

OUTPLANTING

- Your kilioe will be ready for outplanting in six to eight months, when they have outgrown 6-inch to 1-gallon pots and are growing healthily.
- Choose a site in partial sun and provide an area for the kilioe to grow over, or plant it near a large shrub or tree, or along the ground; the reddish leaves would stand out nicely if planted in a black cinder mound.
- Amend the area for good drainage by following recommendations.
- Foliar feed your plants monthly and add 8-8-8 NPK fertilizer quarterly.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Embelia* plants; use a systemic pesticide and control them according to the protocols for ants.

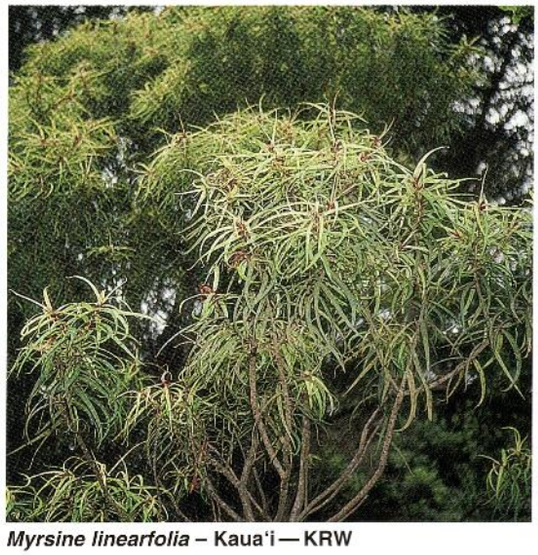
MYRSINACEAE

(MYRSINE FAMILY)

GENUS:
Myrsine

HAWAIIAN NAMES:
Kōlea; ʻōliko; kōlea lau nui

SPECIES:
There are nineteen endemic species found on all the main Hawaiian Islands.



Myrsine linearfolia – Kaua'i — KRW



Myrsine lanaiensis – Maui — F&KS

Partial Sun

Range
Hawaiian Endemic

Description
spindly shrub to small tree

Propagation
seeds

GENERAL DESCRIPTION

The kōlea is a spindly shrub to small tree occurring in a wide range of habitats from dry, diverse mesic to wet forests and even in bogs. It is one of the most abundant trees in the wetter habitats through the islands. They are easily recognized by the bright magenta color of the new foliage and the large, leathery, alternate leaves that develop in several shapes and sizes. The small flowers are both dioecious (male and female flowers on separate plants) and perfect (flowers with both sexual parts on the same plant), depending on the species, and come in an array of colors from yellowish-white to purplish-pink. The drupes (fruits) are small and roundish, tightly clustered along the stems at the leaf axils. They turn dark purple when ripe and mature, each containing one seed.

The Hawaiians used the red sap for dyeing kapa, and the logs for beating kapa; the wood was also used as timber for building houses (Neal 1965). Kōlea is a very slow-growing plant in cultivation, taking many years to become a tree if grown at the right elevation. The plants thrive in the higher, cooler altitudes. I suspect that the viability of the seeds is determined by the size of the population and whether the flowers are dioecious or not. Some of the seeds I have received had a high germination rate and others had very low to no germination response at all.

Entire Range: Hawaiian endemic

Wild Habitat: Depending on the species, occurs in diverse mesic, wet forest, dry forest, and open lava fields, also in bogs, bog margins, near streams, and in cloud-swept forest summits

Habit: Trees or shrubs

Mature Height: 0.3–8 m

Stem/Trunk: Branching sometimes with lenticels, branches are brown, reddish-brown, green, to a dark purplish-brown

Leaves: Variable leaves depending on the species, from thin and linear to wider and oval; all leaves are simple, alternate, dotted with pits or secreting canals, margins are entire to toothed, and new leaf growth is reddish

Inflorescence/Flower: The small flowers are perfect or unisexual, depending on the species; the flowers are yellowish-white to purplish-pink; they can arise from the axils, in umbels, or inflorescences; the calyx is four- to five-lobed; the corolla (persistent) is four- to five-lobed; the flower has a superior ovary

Fruit: Fruit a globose drupe with a thin, dry, leathery, or woody endocarp

Seed: One seed per fruit (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Myrsine juddii* fruit – O'ahu—SP**

- To propagate from seeds, first collect the drupes when ripe and dark purplish in color; keep them moist in a plastic bag until cleaning. The seeds can be stored in the refrigerator.
- Separate the seeds from the pulp as recommended for medium pulpy seeds; also remove the thin coat under the pulp by rubbing against the strainer.
- Soak the seeds in tap water for twenty-four hours or hand-hot water for twelve hours.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1); cover the seeds with ½ inch of additional mix.
- For seeds collected from a bog habitat, surface sow the seeds onto moist sphagnum moss and put them under a mist system (scheduled on 6 AM to 6 PM).
- Keep the flats in a covered, shaded area, and water them every other day.
- Once the seedlings sprout, foliar feed them with a weak fertilizer solution monthly to keep them strong.

GERMINATION

- It will take between one and eight months for all viable seeds to sprout.
- When you see four to six true leaves develop after a few months, your plants will be ready to transplant.
- Transplant them into 2-4-inch pots using a well-draining mix as recommended.
- Keep the seedlings in a shaded area, protected from heavy rains and wind.
- Repot them into larger pots every four to six months; use a cindery soil mix for best growth.
- Move them into an area in partial sun to prepare them for outplanting and to harden them off.

OUTPLANTING

- Your kōlea plants will be ready for outplanting in one to two years, when they have outgrown their 1–2-gallon pots and are growing healthily.
- Choose a site close to the elevation the seeds originated from, in partial sun, with other plants under a large tree for example with some kilioe (*Embelia*) as a sprawling ground cover.
- Apply small amounts of 8-8-8 NPK fertilizer every three to six months for healthier growth.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Myrsine* plants; use a systemic pesticide and control them according to the protocols for ants.
- Red spider mites are tiny red mites that live on the underside of leaves, sucking out the chlorophyll and causing the leaves to yellow and fall off with time. Spray under leaves with water when watering, or rotate spray with horticultural oils (neem or mitecides).
- Infestations of thrips can occur. If they do, control them as recommended; systemic pesticides are the most effective.
- Black twig borers lay their eggs into the stem of the young plants, and then the larvae eat the pith, killing or damaging the young plants. If you discover the black twig borers in your kōlea, cut off all affected parts. What remains of the plant will sometimes grow back, depending on the age of the plant. Also apply a systemic pesticide and follow the directions on the label.

M

MYRTACEAE

(MYRTLE FAMILY)

GENUS:
Eugenia

HAWAIIAN NAMES:
Nīoi

SPECIES	STATUS	HAWAIIAN RANGE
E. koolauensis	E	end (O, Mo)
E. reinwardtiana	—	ind (K, O, Mo, M)

Full Sun – Partial Sun

Range
Endemic or Indigenous[1]

Description
shrubs to trees

Propagation
seeds



***Eugenia reinwardtiana* fruit – Kaua'i — DL**

GENERAL DESCRIPTION

This family consists of some of our favorite fruits, which have naturalized in degraded forests, such as guava, strawberry guava (*Psidium* spp.), surinam cherry (*Eugenia uniflora*), mountain apple (*E. malaccensis*), and the weedy java plum (*E. cuminii*). The nioi occur on dry forest slopes occasionally in mesic forests as small trees or shrubs with branches and new growth covered with brown soft hairs; the older leaves are more smooth and glossy. Small flowers emerge from leaf axils with tiny, short, brown hairs; the fleshy yellow-orange to yellow-red small sweetish edible berries contain one to two seeds. Nīoi are endangered and occur in small populations due to poor seed viability. *E. reinwardtiana* is the easier of the two to grow and maintain in the landscape

Entire Range: Hawaiian endemic to O'ahu and Moloka'i (*E. koolauensis*); indigenous, widely distributed in the Pacific, Borneo, Malaysia, Micronesia, Tuamotus, and Hawai'i: K, O, Mo, and M (*E. reinwardtiana*)

Wild Habitat: Dry gulches, slope, dry forest slopes, and mesic forests

Habit: Small trees or shrubs

Mature Height: 1.5–7 m height

Stem/Trunk: Branches covered with fine brown hairs, dense in *E. koolauensis*, on young branches in *E. reinwardtiana*

Leaves: Leaves opposite, pinnately nerved, dotted, leathery, elliptic to ovate and with leaf stalks. The lower surface of *E. koolauensis* is covered with a dense coating of fine brown hairs; the lower surface of *E. reinwardtiana* is smooth or slightly covered with fine hairs.

Inflorescence/Flower: Flowers borne out of the leaf axils, in racemes, each flower with four sepals, four white petals and about 150 stamens inserted on the nectary disk; with white filaments; inferior ovary

Fruit: Fruit a berry with a thin covering (mesocarp), yellow to red, ovoid about 1–2 cm long

Seed: Seeds are usually one per fruit, round (globose), and about 8 mm in diameter (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate your plants by seed, first collect fruits when they are orangish-red and soft and shedding from the plant.
- Keep them moist in a plastic bag and separate the small seeds from the pulp as recommended.
- Do not store the seeds. For best results start them fresh; no pretreatments are necessary.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) and cover the seeds with ½ inch of additional mix; water them in.
- Keep the seed flat in a shaded, covered area.

GERMINATION

- Germination will occur in one to three months.
- Foliar feed the seedlings with a weak solution monthly.
- Wait two months for at least four to six true leaves to develop.
- Transplant them into cindery, well-draining media, adding a small amount of 8-8-8 NPK fertilizer.
- Keep the seedlings in the shade and foliar feed them monthly.
- Repot them when the plants are twice as tall as the pots they are in, about every four to six months.
- Move them into increased amounts of sun to harden them off for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in about one year, when they have outgrown a 1–2-gallon pot.
- Choose a site that has full to partial sun with well-draining cindery soil and on the dry side; amend the ground as recommended.
- Plant your nioi with other plants, such as ground covers, or near an ʻōhiʻa lehua tree for protection.
- Add a small amounts of 8-8-8 NPK fertilizer quarterly.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Eugenia* plants; use a systemic pesticide and control them according to the protocols for ants.
- Chinese rose beetles eat small round holes in the leaves slowing down photosynthesis and plant growth. Top dress soil around plant with thick, well-decayed compost; apply systemic pesticides.

M

MYRTACEAE

(MYRTLE FAMILY)

GENUS:

Metrosideros

HAWAIIAN NAMES:

ʻŌhiʻa; ʻŌhiʻa lehua; lehua

SPECIES	STATUS	HAWAIIAN RANGE/ DESCRIPTION
M. macropus	—	end (O) yellow to red flowers
M. polymorpha var. *dieteri*	—	end (K)
M. polymorpha var. *glaberrima*	—	end (Hi exec. Ni, Ka) yellow, orangish to red flowers
M. polymorpha var. *incana*	—	end (O, Mo, L, M, H)
M. polymorpha var. *macrophylla*	—	end (M, H)
M. polymorpha var. *newellii*	—	end (H)
M. polymorpha var. *polymorpha*	—	end (O, Mo, L, M, H) red to yellow flowers
M. polymorpha var. *pseudorugosa*	—	end (M)
M. polymorpha var. *pumila*	—	end (K, O, Mo, M)
M. rugosa	—	end (O) red flowers
M. tremuloides	—	end (O) red flowers
M. waialealae var. *fauriei*	—	end (Mo, L, M) red flowers
M. waialealae var. *waialealae*	—	end (K) red flowers

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds and air-layering



ʻŌhiʻa buds, flowers & seeds — KLR

GENERAL DESCRIPTION

There are many forms of ʻōhiʻa; their seeds are wind dispersed, and the seedlings readily adapted to the many different habitats on the islands, from dry forests to bogs. Larger, rounded trees with smooth, oval-shaped leaves are found in wetter forests, whereas drier environments have produced smaller trees or shrubs with small, whitish hairy leaves to counteract the bright sun and dry conditions. Bog species are very small, only about 6 inches in height, and consist only of a few branches and sometimes even grow epiphytically on wet mossy logs. ʻŌhiʻas are the most dominate tree in the Hawaiian forest and are genetically healthy because of their large and diverse populations. They hybridize easily, which results in many subspecies. Very tiny (dust-like) golden seeds develop in cup-like structures at the ends of the branches. They turn brown when they mature and they start to split open along their seams. Sometimes you can tell what color the flowers are going to be by the color of the seedling stems. For example, typically when seedlings are 1–2 inches tall, if they have pale yellow stems they will produce yellow flowers, and if they have red stems they will produce red flowers.



'Ōhi'a seeds — KLR

Rapid 'Ōhi'a Death/Ceratocystis Wilt of 'Ōhi'a: A newly identified disease has killed large numbers of mature 'ōhi'a trees (Metrosideros polymorpha) in forests and residential areas of the Puna and Hilo Districts of Hawai'i Island. Pathogenicity tests conducted by the USDA Agriculture Research Service have determined that the causal agent of the disease is the vascular wilt fungus, *Ceratocystis fimbriata* (Keith and others 2015). Although a different strain of *Ceratocystis fimbriata* has been present in Hawai'i as a pathogen of sweet potato for decades (Brown and Matsuura, 1941), this is a new strain of the fungus and the first record of any *Ceratocystis* species affecting 'ōhi'a. It is not yet known whether this widespread occurrence of 'ōhi'a mortality results from an introduction of an exotic strain of the fungus or whether this constitutes a new host of an existing strain. This disease has the potential to kill 'ōhi'a trees statewide. (Friday, 2015) UH-CTAHR.

To prevent further spread, do not transport any 'ōhi'a plant material to other islands or different districts on Hawai'i Island.

Entire Range: Hawaiian endemic to all of the main islands except Ni'ihau and Kaho'olawe

Wild Habitat: Bogs, dry, mesic, and wet forests

Habit: Stunted, prostrate shrubs, small trees to tall branching dominant forest trees

Mature Height: 0.1–30 m

Stem/Trunk: Bark fissured, light colored

Leaves: Leaves opposite, flattened (dorsiventral), size and shapes variable with species and habitats; some species or varieties have narrow lanceolate leaves, while others have obovate leaves

Inflorescence/Flower: Flowers red, orangish, and occasionally yellow; flower parts in multiples of five, flowers on pedicels, or occurring without a flower stalk, flowers borne from leaf axils, terminally or pedunculate inflorescences, or flowers solitary. Stamens numerous, extended twice as long as petals, giving the appearance of a "powder puff."

Fruit: Fruit a capsule

Seed: Seeds are narrow, linear, tiny, and numerous (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the capsules when they are brown, dry, and splitting open; keep them dry in a paper bag until cleaned.
- Separate the tiny seeds by opening the capsules by hand or as recommended for small dry seeds.
- The seeds can be stored in a desiccation chamber for no longer than three years, or refrigerated; germination results will be higher with freshly collected seeds.
- Seeds left at room temperature for a few months will also lose viability.



Metrosideros polymorpha 4 month old seedlings – NTBG nursery — KLR

- Surface sow the tiny seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), or onto fine black cinder in a shallow flat 3 inches deep. Water the seeds in and keep them moist, then water every other day.



ʻŌhiʻa lehua one-year-old seedling – NTBG — KLR

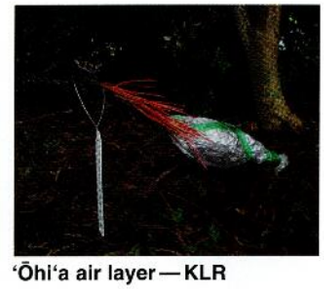
- Keep the flats in a shaded, covered area.
- Once the seedlings have germinated, foliar feed them monthly, using a weak solution.

GERMINATION

- Germination of all viable seeds can take from two weeks to three months.
- Very small seedlings need at least four true leaves (which can take about six months) before handling, and then only handle carefully by the leaves or small root balls (not the delicate stems); follow the directions for transplanting.
- Transplant into 2-4-inch pots. Important: be sure that the mix is well-draining, use 3 parts black cinder to 1 part potting mix or other well-draining mix (3:1), adding small amounts of 8-8-8 NPK fertilizer.
- Keep the seedlings in a shaded area; repot them in four to six months, when they are twice as tall as their pots. The roots are very sensitive during this period; try not to disturb them at this time.
- Foliar feed them monthly, and move them into partial sun to harden them off and prepare them for outplanting.

AIR LAYERING (easy)

- To make certain you get the ʻōhiʻa flower you desire, air layering is a guarantee
- Follow the directions for air layering; the air-layers should be rooted in three to six months; use rooting powder Nos. 8–30, which all work.



ʻŌhiʻa air layer — KLR

- Do not attempt to air layer unless the bark is slipping (when it is removed from the stem easily)
- ʻŌhiʻa trees grown from seed have a healthier more established root system, making for stronger trees in the long run. Air layers which have younger roots growing from the bark, need more care to survive outplanted.

OUTPLANTING

- Your ʻōhiʻa will be ready for outplanting in about two years when they are growing healthily and have outgrown a 2-gallon pot.
- Choose a site in partial to full sun, in well-draining soil, out of strong winds, and amend the ground as recommended. Plant with other plants like shrubs and ground covers.
- Poor soil drainage will eventually kill the ʻōhiʻa.
- Water them in, then monitor them weekly for moisture; water when it is dry, and in times of prolonged drought.
- Add small amounts of 8-8-8 NPK fertilizer every three to six months, and work the fertilizer into the soil.
- These are fairly easy plants to maintain in the landscape, with only a few problems; try to plant the ʻōhiʻa in a similar environment to where it was originally collected from for the best results.

PESTS

- Chinese rose beetle will eat holes in the leaves; apply a systemic pesticide as recommended.
- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Metrosideros* plants; use a systemic pesticide and control them according to the protocols for ants.
- Whiteflies might attack your ʻōhiʻa; when they do, wash them off with water by hand, or spray following the recommended directions.

MYRTACEAE

(MYRTLE FAMILY)

GENUS:

Syzygium

HAWAIIAN NAMES:

'Ōhi'a hā; kauokahiki; pā'ihi

SPECIES	STATUS	HAWAIIAN RANGE
S. sandwicense (syn: *sandwicensis*)	—	end (K, O, Mo, L, M)

M



***Syzygium andwicense* fruit – Kaua'i — DR**

Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds and air-layering

GENERAL DESCRIPTION

'Ōhi'a hā is a native mountain apple with small edible fruit. It occurs in mesic to wet forests and bogs, primarily on ridges and slopes. 'Ōhi'a hā grows as shrubs to trees up to 60 feet tall with tough, flexible, glossy opposite leaves 3–6 inches long. The flowers cluster along the branches from leaf axils and are small pinkish-white; later small, red, berries develop containing one to two hard roundish seeds. The Hawaiians used the wood for house building and for fuel; bark produced a black dye for kapa (Wagner et al. 1990). 'Ōhi'a hā stands out beautifully in the forest when in full bloom. The experience I have had with 'ōhi'ā ha seeds is not promising; I received only small amounts of seeds at a time, and none of the seeds germinated. For some reason, these plants tend to produce aborted embryos; the cause could be unhealthy growth from depleted soils and/or drought conditions.

Entire Range: Hawaiian endemic to Kaua'i, O'ahu, Moloka'i, Lāna'i and Maui

Wild Habitat: Ridges and slopes in mesic to wet forests and bogs, 230–1,220 m elevation

Habit: Shrubs or trees

Mature Height: 3–25 m height

Stem/Trunk: Bark grayish-brown to reddish-brown, with longitudinal strips, unarmed

Leaves: Leaves opposite, leathery, smooth, pinnately nerved, oval to lance-shaped about 10 cm long by 3 cm wide; leaf stalks about 1 cm long



S. sandwicense – Maui—F&KS

Inflorescence/Flower: Flowers in axillary, simple or compound cymes about 5 to 8 cm long, peduncles 2.5 to 3.5 cm long, pedicels 2 to 4 mm long with 4 miniute sepals, 4 white to greenish petals; stamens about 20 to 30 with white to pinkish filaments; ovules 4 to 10 per cell

Fruit: Pink to red berries, roundish (globose) to ellipsoid about 1 cm long, outer fruit (pericarp) fleshy

Seed: Seeds round to ellipsoid, about ½ cm in diameter (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the berries when they are soft and reddish in color; keep them moist in a plastic bag until cleaned.
- Separate the pulp from the seeds by hand or as recommended for medium pulpy seeds.
- Start the seeds fresh; viability will be lost by seed storage.
- Soak the seeds in tap water for one hour, then sow them onto a mix made up of 3 parts perlite to 1 part potting mix (3:1), cover them with ½ inch of additional mix.
- Keep the flats in a covered, shaded area; keep them moist and water them every other day.

GERMINATION

- Germination will occur in about one to six months; wait until at least four true leaves develop before transplanting into 3-4-inch pots.
- Use a well-draining mix made up of 3 parts black cinder to 1 part peat moss (3:1), adding small amounts of 8-8-8 NPK fertilizer to the mix.
- Keep the seedlings in a shaded area; repot them into larger pots after four to six months.
- Foliar feed them monthly, move to an area with partial sun to help harden them off.

AIR LAYERING

- Follow directions for air layering; use rooting powder Nos. 8 or 16 for the best results.
- Your air layers should be rooted in about three to five months.

OUTPLANTING

- Your *Syzygium* will be ready for outplanting in about one to two years, when they have outgrown a 1–2-gallon pot.
- Choose a moist site with partial sun and a well-draining soil; amend the ground as directed.
- Water them in, then water weekly until new growth appears; monitor them often for soil moisture and water them when it is dry.
- Foliar feed them monthly and add small amounts of 8-8-8 NPK fertilizer every three to six months.

PESTS

- Chinese rose beetle eats holes in the leaves; place a solar night light near the plant or treat them with systemic pesticides as recommended.
- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Syzygium* plants; use a systemic pesticide and control them according to the protocols for ants.

NYCTAGINACEAE

(FOUR-O'CLOCK FAMILY)

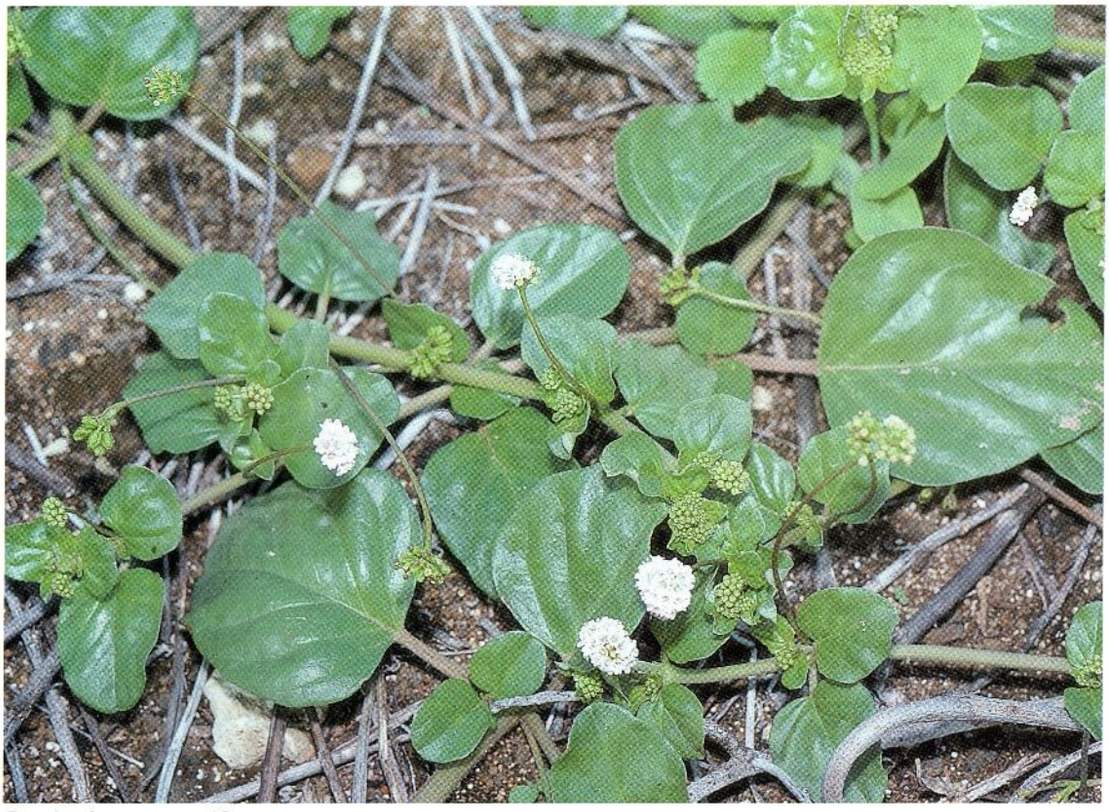
GENUS:

Boerhavia

HAWAIIAN NAME:

Alena

SPECIES	STATUS	HAWAIIAN RANGE
B. acutifolia (syn. *glabrata*)	—	ind (HI)
B. herbstii	—	end (O, L, M, Ka, H)
B. repens	—	ind (Kl, Le, HI)



Boerhavia repens—JO

N

Full Sun

Range
Endemic and Indigenous[1]

Description
herb

Propagation
seeds and cuttings

1: Range differs for each species.

GENERAL DESCRIPTION

Alena fruits are covered with a sticky, gluelike material. It adheres easily to coastal bird feathers, which is how *Boerhavia* became widely dispersed throughout the Pacific. *Boerhavia* is a low-growing perennial herb with pinkish stems found growing along coastal shores; weed-like on rocky slopes and ridges. The leaves are egg-shaped and pale green. The small, clustered whitish-pink flowers form on longish spikes borne from the leaf axils. When it is outplanted, it will regenerate itself easily, producing many viable seeds.

Entire Range: Hawaiian endemic

Wild Habitat: Shores, sea cliffs, open slopes, behind beaches and ridges

Habit: Prostrate, robust, perennial herb

Mature Height: Not relevant

Stem/Trunk: Prominent nodes, branching sparingly to many branched

Leaves: Leaves simple, opposite, margins entire, leaves ovate to narrowly ovate, petioles about 0.5-0.3-1-2 cm long; leaves pale green above, lower surface pale

Inflorescence/Flower: Flowers small, perfect, in axillary cymes, distally numerous, there is no corolla, the calyx is five lobed, whitish-pink, ovary superior

Fruit: Fruit an indehiscent (not opening) achene, anthocarp (ovary surrounded by perianth tube), ribbed, glandular in furrows, and sticky
Seed: Seed have endosperm, one seed per fruit (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seeds, first collect the small, dry, brown sticky capsules; keep them dry in a paper bag until separated.
- Remove the small rounded seeds as recommended for small dry seeds.
- Surface sow seeds on a flat of 3 parts perlite to 1 part vermiculite or perlite (3:1), water in, keep mix on the dry-side.
- Keep them in a covered area, protected from heavy rains.

GERMINATION

- You can expect germination in about one to three months.
- Transplant them into 2-inch pots with a well-draining sandy or cindery mix.
- Repot them into larger 4-inch pots, in about three to five months; keep them on the dry side.

CUTTINGS

- To grow from cuttings, first collect softwood cutting material as recommended.
- Remove the lower leaves; no rooting powders are necessary.
- Insert one to two nodes under a moistened mix of 3 parts perlite to 1 part vermiculite (3:1).
- Keep them in a covered area, watering every two days, keep them on the dry side.
- You can expect rooting in about two to three months; transplant them into 2-6-inch pots (depending on the root size) with well-draining sandy or cindery soil.
- Foliar feed them monthly. Move into full sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- For outplanting, find a dry site with full sun and well-draining sandy or cindery soil; amend as recommended.
- Water them in at first, and then water only in times of prolonged drought.
- Apply small amounts of 8-8-8 NPK fertilizer every four to six months for healthy growth.
- This is an easy plant to maintain in a coastal landscape and is an attractive ground cover.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your alena plants; use a systemic pesticide and control them according to the protocols for ants.

NYCTAGINACEAE

(FOUR-O'CLOCK FAMILY)

GENUS:

Pisonia

HAWAIIAN NAME:

Pāpala kēpau; pāpala

SPECIES	STATUS	HAWAIIAN RANGE
P. brunoniana	—	ind (O, Mo, L, M, H)
P. grandis	—	ind (M?) not seen since 1825
P. sandwicensis	—	end (HI exc. Ni, Ka)
P. umbellifera	—	ind (HI exc. Ni, Ka)
P. wagneriana	R	end (K)



***Pisonia* sp. flowers and fruit – Hawai'i — DR**

Full Sun – Partial Sun

Range
Endemic or Indigenous[1]

Description
shrubs to trees

Propagation
seeds

1: Range differs for each species.

GENERAL DESCRIPTION

Large shrubs or trees in prime growing conditions up to 50 feet tall, occurring in dry to mesic forests. Leaves whorled to opposite, arranged pointed and glossy green. Small, greenish-white, fragrant flowers are unisexual (either male or female), clustering at branch ends. Fruits are many, 1 inch long, slender. The pāpala kēpau has very sticky (kēpau) fruits that were once used to trap native birds for their colorful feathers, which were used in the making of feather cloaks and helmets for the royal high chiefs (Abbott 1992). The sticky fruits are messy when handling and cleaning. *Pisonias* sticky fruits increased its likelihood of being dispersed by seabirds to isolated islands. Sometimes smaller seabirds are killed

from an abundance of these seeds glued to their feathers, impairing flight.

Entire Range: Indigenous and Hawaiian endemic

Wild Habitat: Dry to mesic forests

Habit: Trees or large shrubs

Mature Height: Up to 30 m tall

Stem/Trunk: Soft, brittle wood, loosely branched, terminal nodes enlarged

Leaves: Leaves opposite to whorled, broadly elliptic to elliptic ovate ranging (depending on the species) from 5 cm wide by 15 cm long to 10 cm wide by 30 cm long, stipules lacking

Inflorescence/Flower: Flowers perfect (*P. brunoniana*) or unisexual (all other *Pisonia* species discussed here) depending on the species, flower parts in multiples of five, superior ovary, nectar disk present,

Fruit: Fruit (achene), enclosed in the persistent perianth tube (anthocarp) with five ribs; the fruit is very sticky

Seed: Seeds are small, brownish, and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the fruits when they are brown and dry; keep them dry in a paper bag until cleaning.
- Cleaning the tacky pulp from the seeds will ensure faster germination; seeds with the pulp left intact will germinate, but it may take twice as long.
- No pretreatments are necessary.
- Separate the small brownish seeds as recommended for small dry seeds.
- Sow the seeds onto a mix made up of 3 parts perlite to 1 part potting mix; cover with ¼ inch of additional mix, then water the seeds in.
- Keep them in a covered area and water them every other day.

GERMINATION

- You can expect all viable seeds to germinate in about one to three months; wait until at least four true leaves develop before potting up.
- Transplant the seedlings into 3-4-inch pots of well-draining mix as recommended.
- Keep them moist and in a shaded area, slowly moving them into partial sun.
- Repot them into larger pots with small amounts of 8-8-8 NPK fertilizer when they are twice as tall as their pots; this should be in about four to six months.
- Foliar feed them monthly for stronger growth while they are in pots.

CUTTINGS

- To propagate by cuttings, collect semi-hardwood to hardwood cuttings and follow the directions for preparing these.
- Use rooting powder No. 3 for semi-hardwood and No. 8 for hardwood cuttings.
- Set the cuttings in straight perlite or black cinder under a mist system or in a moist, shaded area; do not allow the mix to dry out at any time while they are rooting.
- The cuttings should root in about two to three months; when they do they are ready to be transplanted into 5-6-inch pots; care for them in the same way as you care for the seedlings.

OUTPLANTING

- When your plants are ready for outplanting place them in an area with full to partial sun and well-draining soil; amend as recommended.
- Plant them with shrubs and ground covers.
- Water them in, and then monitor them weekly for moisture. Water them if it is dry.
- Add small amounts of 8-8-8 NPK fertilizer that is worked into the soil, every three to six months.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your *Pisonia* plants; use a systemic pesticide and control them according to the protocols for ants.
- Use a solar night light close by or systemic pesticide as recommended for insects that may be eating the leaves.

OLEACEAE

(OLIVE FAMILY)

GENUS:

Nestegis

HAWAIIAN NAMES:

Olopua; pua; ulupua

SPECIES	STATUS	HAWAIIAN RANGE
N. sandwicensis	—	end (HI exc. Ni, Ka)



***Nestegis sandwicensis* flowers – Moloka'i — DL**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds and cuttings

GENERAL DESCRIPTION

The olopua is an evergreen tree 25–80 feet tall found commonly in dry forests, with shiny crinkled, leathery leaves 3–6 inches long. Clusters of small, pale yellow flowers develop from the leaf axils on short-branched spikes, as do the small purplish-blue drupes ½–1 inch long that resemble olives and contain one solid thick seed. The strong hardwood was used by Hawaiians for tools such as the 'ō'ō (digging sticks), rasps to sharpen fish hooks, fishing spears, and adze handles (Wagner et al. 1990). Olopua is an easy, larger tree to grow and maintain in the landscape, tolerating the drier environments. I have done a few tests with these stony seeds using hand-hot and tap water soaking for different amounts of time, up to several days. I also tried seed scarification; germination took three to five months no matter what I did.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Trees
Mature Height: 8–25 m

Stem/Trunk: Bark is thick and corrugated

Leaves: Leaves simple, opposite, leathery, narrow and lance-shaped to elliptic, about 12 cm long by 5 cm wide, upper surface smooth and glossy, lower surface dull and pale

Inflorescence/Flower: Flowers in axillary inflorescences about 3–6 cm long; flowers in multiples of fours, four stamens, corolla with four-lobes, ovary two-celled with two ovules per cell

Fruit: The fruit is a one-seeded drupe, green when immature, ripening to bluish-black; ovoid and about 2 cm long

Seed: Seeds have a hard seed coat (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the drupes when they are dark purple and shedding from the tree; keep them moist in a plastic bag.
- Separate the seeds as recommended for medium pulpy seeds.
- Start the seeds fresh because storage reduces viability.
- Soak the seeds in hand-hot or tap water for twelve to twenty-four hours. After this soaking period, discard any floating seeds.
- Sow in a mix of 3 parts perlite to 1 part potting mix (3:1), cover the seeds with 1 inch of mix, and then water the seeds in.
- Keep the flats in a covered, shaded area. Once the seedlings start to germinate, foliar feed them monthly.

GERMINATION (slow)

- Germination is usually slow, and it can take from three to nine months for all viable seeds to sprout.
- Once they produce four to six true leaves, transplant them into 3-4-inch pots; use a well-draining mix.
- Keep them in a shaded area, foliar feeding them monthly.
- Repot them into larger pots every six to nine months when they are twice as tall as their pots.
- Move them into full sun to harden them off for outplanting.

CUTTINGS

- To clonally propagate the olopua, collect green, softwood cuttings in the mid to late summer, follow directions for softwood cuttings.
- Rooting powder Nos. 3–8 work well.
- Keep them under a mist system until rooted, which takes about three to four months.

OUTPLANTING

- Your olopua will be ready for outplanting in about one year, when the plants have outgrown a 1–2-gallon pot.
- Choose a site in full to partial sun with well-draining soil and amend as recommended.
- Water them in, then monitor the plants weekly for moisture; water them if it is dry until they are established with a few inches of new growth.
- Add small amounts of 8-8-8 or 14-14-14 NPK fertilizer quarterly to the soil.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your olopua plants; use a systemic pesticide and control them according to the protocols for ants.
- Infestations of thrips can occur, turning the under-side of leaves whitish. If they do, control them as recommended with systemic pesticides.

ORCHIDACEAE

(ORCHID FAMILY)

O

GENUS:	COMMON NAME:
Anoectochilus	**Jewel Orchid**

SPECIES	STATUS	HAWAIIAN RANGE
A. sandvicensis	R	end (HI exc. Ni, Ka)

GENUS:	COMMON NAME:
Platanthera	**Fringed orchid**

SPECIES	STATUS	HAWAIIAN RANGE
P. holochila	E	end (K, O, Mo, M)

GENUS:	HAWAIIAN NAME:
Liparis	**'Awapuhiakanaloa**

SPECIES	STATUS	HAWAIIAN RANGE
L. hawaiensis	R	end (HI exc. Ni, Ka)

Shady

Range
Hawaiian Endemic

Description
herb

Propagation
seeds



***Anoectochilus sandvicensis* flowers – O'ahu — SP**



***L. hawaiensis* flowers — F&KS**

GENERAL DESCRIPTION

The orchid family is the largest and most diverse flowering plant family, with more than 800 genera and 25,000 species, mostly in the tropical regions of the world. Although people in Hawai'i enjoy seeing a profusion of orchids, few see the ones that are native to Hawai'i. This is because there are only three endemic species (only found in the Hawaiian Archipelago) and of these three, they are all threatened or endangered, even though Hawai'i affords ideal habitats for them. There is only one Platanthera holochila plant remaining on Kauai and one on Maui, but neither have been observed recently (NTBG). Orchids have the tiniest seeds in the plant kingdom. The native orchids have very tiny, inconspicuous flowers. The tiny, very light, wind-dispersed seeds are not suited for long ocean travel, or perhaps they are not able to tolerate the freezing temperatures of the upper jet streams. It is also possible that if they



***Liparis hawaiensis* seed capsules – Kaua'i — DR**

did arrive, they could not become established unless the right pollinators were present.

The endemic orchids are not easy to grow from the miniscule seeds. I have not yet had success; I do not even know if the seeds I received were viable from the outset. The nursery is at 15 feet altitude, close to sea level, with hot and humid temperatures that may have been unsuitable for germination. It may be necessary for the native orchids to be grown at the higher cooler elevations where they naturally occur, in healthy natural soils with native beneficial mycorrhizal fungus present. To go out and dig up a wild plant is never a good idea, as the plant can rarely acclimate to the change in temperature. It will suffer from shock, and will usually die.

Entire Range: Hawaiian endemic found on all of the main Hawaiian Islands except Ni'ihau and Kaho'olawe

Wild Habitat: Diverse, mesic to wet forests and bogs

Habit: Decumbent perennial herb (*Anoectochilus*); erect, terrestrial or epiphytic perennial herb (*Liparis*); erect, deciduous herb (*Platanthera*)

Mature Height: 1–6 dm

Stem/Trunk: Succulent rhizomes, rooting at the nodes (*Anoectochilus*); pseudobulbs crowded along and obscuring the rhizome (*Liparis*); stems arising from underground tubers (*Platanthera*)

Leaves: Leaves of *Anoectochilus* with parallel veins, elliptic to ovate; *Liparis* leaves grow out of the apex of the pseudobulbs; leaves pale green, membranous, about 8 cm long by 3 cm wide, *Platanthera* leaves with the midrib impressed on the upper surface, and entire margins

Inflorescence/Flower: Flowers perfect, bilaterally symmetrical, generally greenish-yellow to white, pale green, numerous in loose spikes (*Anoectochilus*); or in terminal, racemose inflorescences (*Liparis*); or open spikes (*Platanthera*)

Fruit: Capsule with three longitudinal seams, which split upon along the mid sections upon ripening

Seed: Tiny seeds, miniscule, numerous, with no endosperm; many orchid seeds associate with fungi to germinate (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when dry and browning and keep them dry in a paper bag until cleaned.
- Separate the very small, dust-like seeds as recommended for small dry seeds.
- Start the seeds as soon as possible as they are generally short-lived.
- Follow the same directions provided for growing fern spores (p.28-29).

GERMINATION

- A native mycorrhizal fungus has to be present in the media and the flat kepted in darkness.
- Be patient and keep the media moist but not soaking wet.
- Mist with distilled water if the media dries out.

OUTPLANTING

- If you have made it to the outplanting stage, congratulations!
- Keep your plants in a pot with a mixture of 3 parts black cinder to 1 part peat moss or 1 part potting mix (3:1) in a cool, shaded place.
- Or choose a site in the higher, cooler elevations with cindery soil. When outplanting cultivated plants, care must be taken to place them next to established plants already associated with this beneficial fungus (Wikipedia, 2014).
- Monitor these precious jewels closely for moisture and proper drainage.
- Foliar feed them monthly with a light solution of orchid fertilizer.

PESTS

- Slugs love small herbaceous plants and feast on their foliage. Bait or remove them by hand as recommended for controlling slugs.



***Platanthera holochila* flower spikes – Maui — SP**

P

PANDANACEAE

(SCREW PINE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Freycinetia	**'Ie'ie; 'ie**	*F. arborea*	—	ind (HI exc. Ni, Ka)



***Freycinetia arborea* fruit – Kaua'i — DL**

Shady

Range
Indigenous

Description
woody climber

Propagation
seeds and cuttings

GENERAL DESCRIPTION

'Ie'ie is a branching, woody climber with ringed stems, about 1 to 2 inches around, and wiry aerial roots. It commonly occurs in mesic to wet forests climbing up trees epiphytically or growing terrestrially along the ground and over rocks. 'Ie'ie most likely arrived in Hawai'i by bird. The long, narrow, pale green leaves form as tufts at branch ends and the flower spikes, up to 5 inches long, develop from the center of the tufts, surrounded by colorful edible bracts green to bright orange. The small, red fruits cluster along the spikes and contain many tiny, long, dust-like seeds. The flowers are unisexual, having all female or all male flowering parts, occurring either on the same plant or one sex on different individuals. It has been recorded that the wind, native bats, or Hawaiian honey creepers (birds) may have pollinated the 'ie'ie; the native bird populations in the lower altitudes have become extinct from avian malaria, and the 'ie'ie populations have become so reduced from habitat destruction that in places only a few plants are left. Their population's no longer overlap, reducing cross-pollination. This may be the reason why so few of the tiny seeds germinate. The Hawaiians considered this plant sacred; the aerial roots were used in making beautiful baskets, helmets, cordage, and fish traps (Abbott 1992).

Entire Range: Indigenous; widespread in Polynesia, New Caledonia, a single record in Samoa, and all of the main Hawaiian Islands except Ni'ihau and Kaho'olawe

Wild Habitat: Mesic to wet forests, often on exposed ridges and slopes, 300–1,500 m altitude

Habit: Branching, woody climbers with adventitious (roots originating from an unusual place, such as along a stem rather than underground), flattened roots used for clasping

Mature Height: Not applicable

Stem/Trunk: Woody, ringed stems about 1 inch (2.5 cm) in diameter, with flattened clasping roots

Leaves: Leaves simple, 3-ranked, parallel veins, leathery, dark green, spirally arranged, linear-lanceolate, about 60 cm long and about 2 cm wide

Inflorescence/Flower: Flowers unisexual, flower parts in multiples of three, terminal inflorescence, outer bracts green with an orange-pink base, fleshy, inner bracts pink, linear. Male flowers form clusters of spikes that are pale orange; female flowers with 3-angles, usually in clusters

Fruit: Fruit is a syncarp; berries ripen to red; they are compressed and oblong about 10 mm long; fruits are dispersed by birds (in Hawai'i and Pacific), and bats (in South Pacific regions), and by both fresh and salt-water

Seed: Seeds are small and ellipsoid, about 1.5 mm long by about 0.5 mm wide; numerous with a firm coat, eventually becoming separated from the endocarp; endosperm fleshy (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate 'ie'ie by seed, first collect the ripe, pulpy red fruits when they are soft and fleshy and keep them in a plastic bag until cleaning.
- Separate the tiny seeds from the slimy pulp as directed for small pulpy fruits.
- Start the seeds as soon as possible, and do not store (they will lose viability).
- Surface sow the seeds onto a mix of 1 part fine black cinder or 1 part perlite to 1 part moistened peat moss (1:1); water them in.
- Keep them in a shaded, covered area, protected from full sun and heavy rains.

GERMINATION

- Germination may occur in one to six months, if at all.
- Transplant them into a well-draining mixture of 3 parts black cinder to 1 part peat moss (3:1).
- Keep them in a shaded area and water every other day.
- Foliar feed them monthly.
- Repot them when they grow twice as tall as the pots they are growing in.

CUTTINGS

- To propagate by cuttings, take cutting material with at least three aerial roots attached. Do not damage these aerial roots at any time.
- Do not allow the cuttings to dry out or get exposed to direct sun.
- Keep them moist in sealed plastic bags until starting.
- Apply a rooting powder of Nos. 3–8 to the cut base ends (not to the aerial roots).
- Place them in a mix of 4 parts perlite to 1 part potting mix (4:1). The mix needs to be moist, but not soaking wet. Keep them out of direct sun.
- Use a 6-inch to 1-gallon pot, making sure that the aerial roots and cutting ends are under the mix.
- New foliage should develop after about four to six months.

OUTPLANTING

- Your plants will be ready for outplanting when they have outgrown a 1-gallon pot in six months to one year and when they are growing healthily.
- Choose a site with both moisture and shade, and with a rich well-draining soil; amend the soil if needed according to recommendations.
- Provide something for the 'ie'ie to climb up such as a strong tree, like koa, or let it grow along the moist ground.
- Foliar feed your plants monthly, monitor them closely for good drainage and moisture, and water when it is dry.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your 'ie'ie plants; use a systemic pesticide and control them according to the protocols for ants.

P

PANDANACEAE

(SCREW PINE FAMILY)

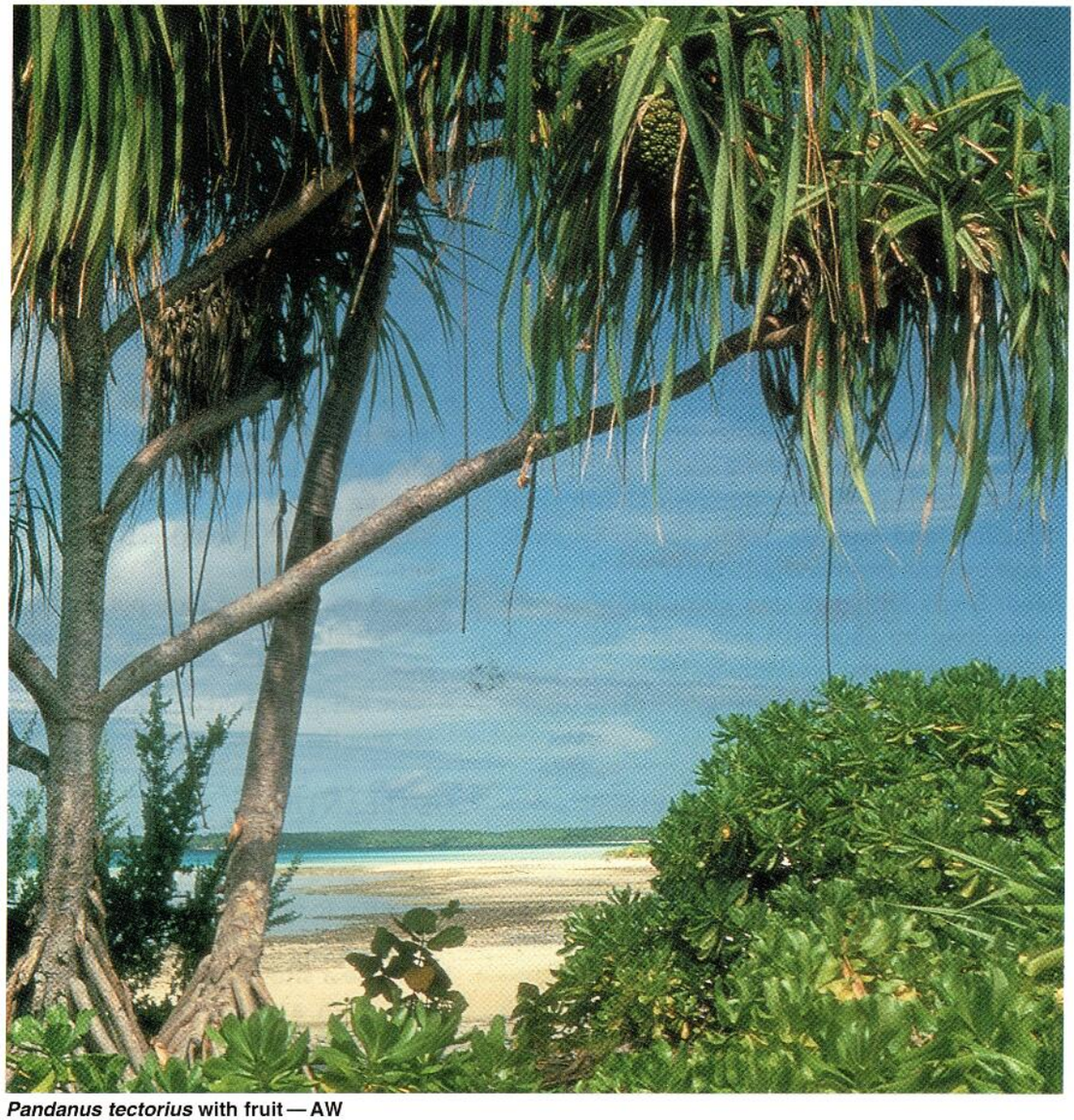
GENUS:	HAWAIIAN NAMES:	SPECIES	STATUS	HAWAIIAN RANGE
Pandanus	**Hala; pū hala**	*P. tectorius*	—	ind? (HI exc Ka)

Full Sun

Range
Indigenous

Description
tree

Propagation
seeds



***Pandanus tectorius* with fruit — AW**

GENERAL DESCRIPTION

The very useful hala tree occurs from coastal habitats to inland mesic valleys. It grows 20–35 feet tall, with many thick aerial roots (ulehala) protruding down from the trunk to the ground, making it seem like the hala tree could walk away at any time. The long leaves (lau hala) are crowded at branch ends in a spiral, with sharp prickles along the edges. Male flowers extend out in a spike, and are surrounded by very fragrant, long, pointed, whitish, edible bracts. The yellow to red edible drupes (pua hala) form in clusters of about fifty at the end of the branches. They look a lot like pineapples growing in the tree. One to three embryos are present in each seed, and sometimes they all sprout at once. Hawaiians made mats, baskets, sandals, pillows, and thatching from the leaves, and sometimes ate the seeds (Wagner et al. 1990). Hala is a fast and easy tree to grow for a coastal planting from the plentiful seeds.

Entire Range: Indigenous to Pacific islands of Polynesia, Melanesia, Micronesia, also New Caledonia to northern Australia, New Guinea, west to the Philippine Islands, Moluccas, and Java; in Hawai'i, on all main Hawaiian islands except Kaho'olawe

Wild Habitat: Mesic coastal regions, from sea level, growing in groves, low elevation mesic slopes, further inland and rarely higher than 610 m elevation.

Habit: Small tree

Mature Height: Reaching 12 m height

Stem/Trunk: Ascending trunk with conspicuous leaf scars, dichotomously branching (branching in twos), or trichotomously (in threes); base of trunk is supported by prop roots, which are sometimes armed

Leaves: Leaves are green (usually), simple, 3-ranked, spiraled, crowded at the branch ends; they can have sharply toothed to smooth margins; they are leathery, smooth, linear, sometimes twisted and from ca. 80-180 cm long, and ca. 408 cm wide. The leaf midrib is keeled on the lower side.

Inflorescence/Flower: Unisexuale (female and male flowers on same tree), terminal inflorescences, with white to cream colored bracts, flowers unisexual with perianth absent, flower parts in multiples of three, four-celled anthers, stamens connate into bundles (male), carpels connate into phalanges, with one ovule per carpel (female), inflorescence a solitary head, closely enveloped by bracts.

Fruit: Polydrupes with five to eleven cells, pericarp yellowish to orange-red when ripe, fleshy-fibrous, endocarp reddish brown and bony. Each fruit is called a "key" and will often begin to sprout right on the ground. A fruiting head has been said to resemble a pineapple growing in a tree.

Seed: Seeds are large, 8–15 mm long, and fusiform-ellipsoid, dispersed mostly by salt water flotation (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seeds, first collect the drupes (fruits) when they are yellowish to red in color and are shedding from the tree.
- Keep them moist in a plastic bag for easy pulp removal.
- Wash the thin layer of pulp off by hand with a scrubber, or clean them as recommended for large pulpy seeds.
- Start the seeds fresh for higher germination rates.
- Soak the seeds in tap water for twenty-four hours. The seeds will float (that is how they traveled to the islands).
- Sow them in a shallow flat on a mix made up of 3 parts perlite to 1 part potting mix (3:1), cover the seeds with about one additional inch of mix, then water the seeds in.
- Keep the flats in a shaded area, and water every other day.

GERMINATION

- Germination will take from one to four months for all viable seeds to sprout; wait until at least four true leaves develop before transplanting them into 4-inch pots using a well-draining mix.
- Keep the seedlings in the shade for a week or so, then move them into full sun.
- Repot them into larger pots in four to six months; make sure the roots do not become root-bound.

OUTPLANTING

- Your hala will be ready for outplanting in about nine to twelve months, or when they have outgrown a 1-gallon pot.
- Choose a site in the lower elevations with full sun and a well-draining soil; amend the ground as directed.
- Water them in, then water weekly when the ground is dry until you observe new growth, then only water in times of prolonged drought.
- Fertilize every six months for healthy growth.
- These are easy, hardy plants to care for; I even have some planted in lava rocks bonsai-style.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your hala plants; use a systemic pesticide and control them according to the protocols for ants.

P

PAPAVERACEAE

(POPPY FAMILY)

GENUS:

Argemone

HAWAIIAN NAMES:

Pua kala; kala; naule; pōkalakala

COMMON NAME:

Hawaiian poppy

SPECIES	STATUS	HAWAIIAN RANGE
A. glauca var. *decipiens*	—	end (H)
A. glauca var. *glauca*	—	end (Le, HI)

Full Sun

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds



***Argemone glauca* – flowers — F&KS**

GENERAL DESCRIPTION

The kala is an erect, perennial herb (short-lived) with a bluish, waxy cast to the plant that contains bright yellow latex. It occurs on the leeward sides in scattered dry coastal and subalpine forests. The kala is believed to be a recent arrival because it has not lost its armor of prickles on the plant surface. The large, attractive, six-petaled white flowers are 3 inches wide and form at the branch tips, as do the prickly 1-inch-long capsules that contain many tiny, round, blackish seeds. The yellow latex contains a narcotic that was used to treat toothaches, ulcers, and neuralgia (nerve pain) (Whistler 1992). These are easy plants to grow and maintain in a dry landscape. The seeds fall to the ground and germinate readily, becoming weedy. These seedlings can be potted up and relocated.

Entire Range: Hawaiian endemic

Wild Habitat: Coastal dry forests and subalpine forests

Habit: Perennial herb

Mature Height: 7–15 dm long

Stem/Trunk: Stems woody at the base, produce yellow latex, and are armed with stiff prickles

Leaves: Leaves are waxy, bluish-white, about 20 cm long and 9 cm wide, deeply pinnately lobed from one half to three quarters of the distance to the midrib; leaf edges are toothed

and tipped with prickles, prickles usually cover the leaf veins

Inflorescence/Flower: The Hawaiian poppy flower resembles the familiar Asian poppy in shape, having six white, broad petals, each about 5 cm long. There can be up to eighty stamens, with pale yellow filaments; the stigma is purple; the ovary is three to six carpellate

Fruit: The capsules are roundish (ovoid) to rounded and elongated lance-shaped; about five cm long, covered with prickles about four mm long

Seed: The seeds are small (2 mm in diameter), dull, blackish-brown, globose, and numerous (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the poky capsules when they are browning and opening at the tip.
- Keep them dry in a paper bag, remove the seeds by turning the capsules upside down to allow the seeds to fall out. Watch out for the sharp prickles; use gloves.



***Argemone glauca* capsules and seeds — KJ**

- Seeds can be stored dry in desiccation or refrigerated.
- Soak seeds first in hand-hot water for twenty-four hours or tap water for thirty-six hours.
- Surface sow them on a dry mix of 3 parts perlite to 1 part potting mix (3:1), and then water them in.
- Keep the seed flat under a covered area, protected from heavy rains.
- Once the seedlings start to sprout, move them into more sun, and foliar feed them monthly.
- Water them when they are dry.

GERMINATION

- These seeds, if not pretreated, can stay dormant in the soil without sprouting for up to two years.
- It may take two to six months for all viable soaked seeds to germinate.
- Wait until they have four true leaves before carefully, (not disturber the delicate roots), transplant into a well-draining mix, into 2-4-inch pots.
- Repot them in two to three months into larger pots as they are fast-growing seedlings.
- Move them into full sun after about a week to harden them off and prepare them for outplanting.
- If the media in the pot dries out completely, the plants will die.

OUTPLANTING

- Your Hawaiian poppies will be ready for outplanting in about six months, when they have outgrown a 4-inch to 1-gallon pot.
- Choose a site in full sun with a well-draining soil; if necessary, amend the soil as recommended.
- The plant has a tendency to lie on the ground; support it if you want, or let it go; they are short-lived plants either way.
- Fertilize every three to six months for strong healthy growth.
- The Hawaiian poppy can be left in a large clay pot as a display plant; use a mix of 3 parts black cinder to 1 part potting mix (3:1).
- Once the plant flowers and seeds and the stem dies back, new shoots will sprout at the base of the plant, along with many seedling from seeds.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your Hawaiian poppy plants; use a systemic pesticide and control them according to the protocols for ants.

P

PHYTOLACCACEAE

(POKEWEED FAMILY)

GENUS:

Phytolacca

HAWAIIAN NAMES:

Pōpolo kū mai; pōpolo

COMMON NAMES:

Pokeweed; pokeberry

SPECIES	STATUS	HAWAIIAN RANGE
P. sandwicensis	—	end (K, O, Mo, M, H)

Partial Sun

Range
Hawaiian Endemic

Description
perennial herb

Propagation
seeds and cuttings



Phytolacca sandwicensis **flowers and fruit – Hawai'i — DL**

GENERAL DESCRIPTION

The native pokeweed is a sprawling, perennial herb occurring in mesic to wet forests. It has hairy stems, usually rambling or climbing in open areas or along streambeds. The large, oval leaves are sometimes slightly hairy to smooth, with small, pinkish to white, five-petaled flowers that group along straight, densely hairy spikes. The small, dark-purple berries contain five to seven black wrinkled seeds. Pōpolo kū mai is an attractive, low-growing plant; it is especially eye-catching when it is outplanted with other plants, trees, shrubs, and ferns.

Entire Range: Hawaiian endemic
Wild Habitat: Open area, stream beds, in mesic to wet forests
Habit: Perennial herb
Mature Height: 8–40 dm
Stem/Trunk: Sometimes woody at the base, the stem sprawling, angular, often with fine, short hairs, more so on the angles
Leaves: Oval leaves, from 8–22 cm long and about 5 cm wide, smooth or covered with fine, short hairs, usually along the veins and lower surface; the leaf margins are entire
Inflorescence/Flower: Flowers are perfect, bilaterally symmetrical, rose pink or occasionally white with five sepals occurring in peduncular racemes, usually about 20 cm long
Fruit: Berries are dark purple when ripe, ribbed longitudinally and about 5 mm in diameter
Seed: Seeds are black, wrinkled, and about 3 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the berries when they are purple and soft; keep them moist in a plastic bag until cleaning.
- Clean them as recommended for small pulpy seeds.
- Do not store the seeds, as they can lose viability; it is best to start them fresh.
- Soak the seeds in tap water for one hour; the viable seeds should sink; discard the floaters.
- Sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), and then cover the seeds with a ¼ inch of mix, and water them in.
- Keep the seed flats in a covered, shaded area, watering them every other day.

GERMINATION

- Germination occurs in one to four months.
- Wait until four true leaves develop before transplanting.
- Use a well-draining mix and pot them into 2-4-inch pots; keep the seedlings in a shaded area.
- Foliar feed them monthly and repot them into larger 4-6-pots when they become twice as tall as their pots.
- Move them into partial to full sun to help harden them off for outplanting.

CUTTINGS

- Take softwood cuttings in morning hours from healthy plants.
- Remove all the foliage and the weak green tips of the cuttings leaving 4–5-inch long pieces with at least 3 nodes.
- Keep moist in sealed plastic bag until starting them.
- Use a shallow flat of 3 part perlite to 1 part vermiculite, No rooting powder needed, insert at least one node under moistened mix.
- Water in cuttings; keep flats in a covered shaded area.
- Rooted in 2 months, pot and care for same as seedlings.

OUTPLANTING

- Your plants will be ready for outplanting in about six months, when they have outgrown a 6-inch to 1-gallon pot.
- Choose a site in the full to partial sun with a moist, well-draining soil; amend the soil as recommended.
- Water the plants in, then monitor them weekly for soil moisture; water them when it is dry until new growth appears.
- These short-lived plants need little to no care and will regenerate themselves in the landscape.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your pōpolu kū mai plants; use a systemic pesticide and control them according to the protocols for ants.

P

PIPERACEAE

(PEPPER FAMILY)

GENUS:

Peperomia

HAWAIIAN NAME:

'Ala'ala wai nui

SPECIES:

There are twenty-three Hawaiian endemic species and two indigenous species (*P. leptostachya*), and (*P. tetraphylla*), found on the main Hawaiian Islands.



***Peperomia alternifolia* seed spikes – Maui — KRW**

Shady – Partial Sun

Range
Endemic or Indigenous[1]

Description
herb

Propagation
seeds and cuttings

1: Range differs for each species.

GENERAL DESCRIPTION

The lovely *Peperomia* of the Hawaiian Islands are small succulent annuals or perennial herbs, widespread and occur often in wet shaded areas growing terrestrial on moist ground, or growing epiphytic on rocks or on mossy tree trunks. The succulent stems are green to reddish and sometimes hairy, with thick succulent leaves that come in many different colors and shapes depending on species and habitat. They have small perfect flowers (having both male and female parts), which develop along spikes that grow above the foliage for easy pollination and later seed dispersal. The seeds are tacky and stick to anything that brushes against them. They do very well planted in black cinder beds in partial shade or on large porous rocks. Poor drainage will rot out the base and roots of these plants in no time. Wild pigs in Hawai'i will root up these plants when they forage for grubs.

Entire Range: Hawaiian endemic and indigenous

Wild Habitat: Wet, mesic, diverse mesic subalpine, dry forests or valleys, margins of bogs, and alpine desert

Habit: Succulent epiphytic or terrestrial annual or perennial herbs

Mature Height: Various

Stem/Trunk: Prostrate, ascending or erect; horizontal taxa produce roots at each node becoming the primary root system

Leaves: Leaves simple, alternate, opposite or whorled, entire margins, with leaf stalks, and without stipules

Inflorescence/Flower: Small, perfect numerous flowers, without petals or sepals, occurring in axillary or terminal fleshy spikes

Fruit: Fruit ovoid and occurring on spikes

Seed: Small seeds with little or no endosperm (Wagner et al. 1990)



***Peperomia* sp. — JJ**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the spikes when they have very small fruits that are loose and falling off.
- Keep them dry in a paper bag until cleaned, follow the directions for small dry seeds.
- The seeds can be stored for a few months in low humidity and in refrigeration.
- No pretreatment is necessary for these very small, sticky seeds.
- Surface sow the seeds onto a fine black cinder or a mix of 3 parts perlite to 1 part potting mix (3:1); water in.
- Keep them moist in a shaded, covered area, watering every other day.
- Monitor them closely because slugs and snails love to eat herbaceous plants.

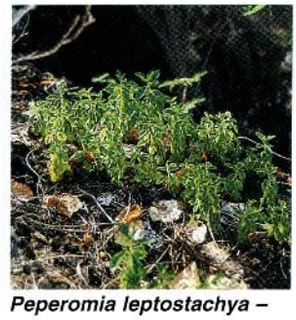
CUTTINGS

- Collect soft stem cuttings and follow the directions for herbaceous cuttings.
- Keep them moist in sealed plastic bag until started, no longer than one to two days.
- Use a mix of 3 parts perlite to 1 part potting mix (3:1) or straight fine black cinder; no rooting powder is needed.
- It is best to keep the flat in a moist, shaded area. Use a mist system if one is available.
- If the cutting mix is not very well-drained, the cuttings will rot.

ROOTING AND GERMINATION

- In three to four months, your cuttings will be rooted and your seedlings sprouted.
- Transplant them into 2–4-inch pots. It is important that the mix is well-draining.
- Keep them in a shaded area protected from full sun and drying winds.
- Foliar feed them monthly and use small amounts of 8-8-8 NPK fertilizer.
- Repot them in six months, when they have outgrown their pots, then move them into partial sun to help harden them off.
- *Peperomia* can live in pots or containers, or outplanted into the garden.

OUTPLANTING



***Peperomia leptostachya* – Kaua'i — RY**

- Your *Peperomia* will be ready for outplanting when they have outgrown a 4–6-inch pot in eight months or so; it is best to outplant them during the rainy season.
- Choose a site with moist, well-draining soil amended with cinder; place them in the shade to partial sun. Try to mimic the environment where they grow in the wild.
- Water them in, then water them when it is dry until they are well established, which is indicated by new growth; foliar feed them monthly.
- Plant them in cinder mounds, on shady rocks, a tree fern (hāpu'u), or mossy tree trunk if they can be given frequent watering when it is dry.

PESTS

- Slugs, snails, and poor drainage will be the biggest pests and problems; use slug bait and amend the mix or soil as recommended for well-draining substrates.

P

PIPERACEAE

(PEPPER FAMILY)

GENUS:

Piper

HAWAIIAN NAMES:

'Awa; kava; pū'awa; awa uli

SPECIES	STATUS	HAWAIIAN RANGE
P. methysticum	—	pol (K, O, Mo, M, H)

Partial Sun

Range
Polynesian Introduced

Description
many branching shrub

Propagation
cuttings



Piper methysticum – **Kaua'i — KLR**

GENERAL DESCRIPTION

In Hawai'i, 'awa grows as a roundish many branching shrub 4–12 feet tall, depending on the variety and habitat. They all have swollen joints (nodes) and stems that emerge from the woody rootstock. There are many different types, depending on the stem and node color, plant shape, and leaf size. The thin, alternate leaves are heart-shaped and about 4–7 inches wide and 8–12 inches long, with 9–13 prominent veins emerging up from the base. The singular, narrowly spiked flowers are unisexual (male and female flowers are borne on separate plants) and in Hawai'i seeds are very rarely set. It is most commonly propagated by jointed stem cuttings. The mother of all 'awa is *Piper wichmannii*, which is capable of producing viable seeds, and over thousands of years has produced the many forms of *P. methysticum*. *P. wichmannii* is a different species from *P. methysticum* and was not used for its narcotic effects. The 'awa plant parts have long been used by Polynesians as an offering of good will in ceremonies and festivals, the mature roots are grated, crushed, or chewed to release kavalactones, which are then mixed with water or coconut milk, producing a tranquilizing drink. When consumed, it induces a sleepy, euphoric state, numbing the mouth and relaxing tight muscles. It is also widely used for medicinal remedies to treat urinary tract infections, headaches, body pains, bronchitis, asthma, stomachaches, and venereal diseases (Whistler 1992). It is a highly valued plant throughout Polynesia.

Entire Range: Polynesian introduction
Wild Habitat: Shaded and open mesic valleys
Habit: Dioecious (male and female plants) shrub; many forms exist and are organized according to stem and leaf shapes, sizes, and colors
Mature Height: 1.5–3 m
Stem/Trunk: Jointed stems, swollen at the nodes
Leaves: Leaves alternate, heart-shaped about 20–30 cm long and about 18 cm wide; palmately veined; the underside of the leaf has a covering of minute hairs on the veins, leaf stalks are about 3 cm long, stipules are persistent.
Inflorescence/Flower: Dioecious flowers (male and female plants), female plants are very rare; male flowers in spikes, white, 3–9 cm long, bracts smooth
Fruit: Does not fruit in Hawai'i
Seed: Does not produce fruit or seed in Hawai'i (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

CUTTINGS

- Collect stem cuttings in the cool morning hours for best results.
- Collect stem cuttings 1–2 inches in diameter; remove all the leaves and the thinner side shoots (they root poorly) and start them immediately, or keep stems moist in a sealed plastic bag and out of direct sun until started. Larger stem cuttings will root, but are harder to handle and root more slowly.
- Cut the stems into 4–10-inch-long pieces with at least two to three nodes; cut just below the nodes at a 45° angle. Single-node cuttings will root but are weaker, and will take months longer to become large enough to outplant and harvest.
- Insert the base ends in No. 3 (Rootone®) with fungicide or use no rooting powder; all cuttings will still root in one to two months.
- Fill a large, wide, 3-gallon pot to the halfway mark (pot size depends on number of cuttings started) with 3 parts perlite to 1 part potting mix (3:1) or 1 part vermiculite (use a sterile potting mix to prevent nematode infection). Moisten and level the mix, then insert the bottom node under the mix. Water lightly just to settle the mix around the cuttings. Be careful not to wash off any rooting powder.
- Keep the pots off of the bare dirt in a covered, shaded area protected from direct sun. Water every other day. Caution: if the mix is kept too wet, the cuttings will rot from fungal disease; if it is kept too dry, cuttings will die from drying out.
- In one to three months your cuttings will have new foliage and a healthy root ball of white, fibrous roots, ready for transplanting into pots.
- Carefully loosen from mix and cuttings without tearing the delicate roots. Transplant them into a 4-inch to 1-gallon pot (depending on the size of the root ball) with a well-draining mix amended with perlite or black cinder. Poor-draining soil will also kill 'awa in time, suffocating the roots. Also add a small amount of 8-8-8 or 10-10-10 NPK fertilizer to the mix.
- Fill the pots halfway with mix; place rooted 'awa, then more mix; water in, securing the stem.
- Keep newly transplanted cuttings in the shade, out of the strong winds, and in two to four weeks, move into partial to full sun to harden them off for outplanting. Water weekly, or when dry.

OUTPLANTING

- It is best to wait until the rainy months of winter.
- For large plantings where you are uncertain of the soil condition, send a soil sample to your local County Agricultural Extension Agent. They can advise you on how to amend your soil for maximum growth and productivity.
- In three to six months after transplanting your 'awa, they will have outgrown their pots and will be ready for outplanting into the ground or repotting into larger pots.
- Choose a site in partial to full sun with well-draining soil, most importantly choose a site that is out of direct winds, which easily rips the large thin leaves.
- Dig a hole a little larger than the pot it is in; amend the soil with well-rotted compost to help naturally combat root-knot nematodes and to add nutrients. If your soil is not well-draining, consider making 3–4-foot mounds of

soil on top of the ground with a compost or mulch top dressing to control fast-growing weeds. Mix in 8-8-8 or 14-14-14 NPK fertilizer (follow directions on manufacturer's label).

- Water the 'awa in well, and then water weekly until the plants are established; let the soil dry out a little between waterings.
- Fertilize larger plantings by adding more well-rotted compost every three months, or you can use 8-8-8 or 14-14-14 slow-release fertilizer instead (but this can get expensive). Foliar feed your plants monthly with Miracle Gro® for healthy greener growth.

PESTS

- Root-knot nematodes are microscopic, eel-shaped worms that live in the soil; they parasitize the roots, forming small round galls that block the flow of water and nutrients to the plant above, leading to yellowing leaves, stunted growth, wilt, and death. Use well-rotted compost that naturally contains nematode predators; control weeds around 'awa to prevent a build up of nematodes and other pests or soil-drench holes with neem oil or other natural horticultural oil extracts.
- Ants living at the base of the 'awa will weaken the roots and they will farm mealybugs, aphids (which transmit viruses to 'awa), and scales; control the insects with natural horticultural oils and use bait for the ants.
- Chinese rose beetles eat small round holes in the 'awa leaves, slowing down photosynthesis and plant growth; top dress soil around plant with thick well-rotted compost.
- Red spider mites are tiny red mites that live on the underside of leaves sucking out the chlorophyll, causing the leaves to yellow and fall off with time. Spray under the leaves with water when watering, or rotate spray with horticultural oils (neem or mitecides).
- Brown or white fungal spots on the leaves usually develop in the rainy seasons in overly moist conditions, or when planted in poor-draining soil. Make sure to use well-draining soil mixes in pots and amend the ground soil for proper drainage, watering only when it is dry.
- Control weeds at the base and around the plants. Weeds harbor pests and compete with 'awa for much needed nutrients and water.
- For major pest problems, contact your local cooperative extension service; they have the latest information on 'awa cultivation and management in Hawai'i.

PITTOSPORACEAE

(PITTOSPORUM FAMILY)

P

GENUS: ***Pittosporum***

HAWAIIAN NAMES: **Hō'awa; hā'awa**

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. argentifolium	R	end (Mo, M) dry to mesic forest
P. confertiflorum	—	end (O, L, M, H) dry to wet and subalpine forest
P. flocculosum	—	end (O) mesic to wet forests
P. gayanum	—	end (K) open bogs, wet forests
P. glabrum	—	end (K, O, Mo, L, M) mesic to wet forests, bog margins
P. halophilum	R	end (Mo) coastal dry forests
P. hawaiiense	R	end (H) mesic to wet forests
P. hosmeri	—	end (H) mesic to wet forests
P. kauaiense	—	end (K) diverse mesic forests and valleys
P. napaliense	R	end (K) hala and mesic valleys
P. terminalioides	—	end (L, M, H) dry, mesic and sub-alpine woodland

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds and cuttings



***Pittosporum halophilum* seed capsules – Moloka'i — KRW**

GENERAL DESCRIPTION

Hō'awa occur in dry, mesic, wet, to subalpine forests. They are quite attractive evergreen shrubs and trees that can be used as landscape ornamentals. The narrow leaves cluster at the branch ends and are sometimes covered with fine brownish hairs (tomentose). Small whitish flowers (perfect or unisexual) are borne along the stems, just below the leaves or in the leaf axils. The large oval woody seed capsules are 2–3 inches long and brightly colored, yellow to orangish-red on the inner surfaces. They contain ten to twenty shiny, sticky orange or blackish seeds that attract birds. The seeds were dispersed to the Hawaiian Islands by birds, either in their stomachs or stuck to their feathers. The capsules have



***Pittosporum hosmeri* flowers — KLR**

evolved to become much larger than when they first arrived to the islands. This loss of dispersibility is characteristic of island species (Carlquist 1980; Grant 1998). The endemic crow, 'alalā, that is nearly extinct, used *P. hosmeri* as a source of food (Neal 1965). It was easy for it to open the woody seed capsules with its strong beak. Hō'awa is an easy plant to propagate and maintain in the landscape although it is slow-growing.

Entire Range: Hawaiian endemic

Wild Habitat: From dry, mesic, wet and subalpine forests to diverse mesic forests, open bogs, valleys, and coastal woodlands

Habit: Shrub to tree

Mature Height: 1–14 m

Stem/Trunk: Pubescent (covered with fine hairs and/or glands), or smooth

Leaves: Leaves are simple, alternate, usually clustered at branch ends, leathery, entire leaf margins or toothed; or margins rolled over at the edges

Inflorescence/Flower: Flowers are perfect or unisexual (either entire plant male or female or a species has both male and female flowers on the same plant); radially or irregularly symmetrical; flowers occur from the axils, or terminal inflorescences; petals in fives, which are white, cream, yellowish-purple, or red. Flowers form a corolla tube.

Fruit: Fruits are capsules which are smooth to wrinkled with a persistent style, the exocarp (outer layer of fruit) is leathery to woody, and the inner layer is fleshy

Seed: Seeds numerous, black to reddish-black, and sticky (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are browning and splitting along the stems.
- Keep the capsules dry in a paper bag until you separate the seeds.
- Crack open the capsules by hand or using a hammer, while being careful not to damage the seeds inside.



Rats eat ho'awa seeds — KLR

- Wash off the sticky white latex from the seeds with soap in a strainer under running water.
- Best to start seeds fresh, soak the seeds in tap water for twenty-four hours; or do not use any pretreatment, as they will still germinate in three to nine months.
- Sow the seeds into a mix of 3 parts perlite to 1 part potting mix (3:1) then cover the seeds with ½ inch of mix.
- Keep them in a shaded, covered area and water every other day.

GERMINATION (slow-growing)

- Germination of seeds can take from three to nine months for all viable seeds to sprout. Some species take longer than others.
- Wait until four to six true leaves develop before transplanting them into a well-draining mix.
- Use 2-4-inch pots, water in the seedlings and then water weekly; foliar feed them monthly.
- Keep the seedlings in a shaded area; repot them into larger pots in five to six months.
- Move them into partial to full sun to harden them off and prepare them for outplanting.

CUTTINGS

- Choose the leafy semi-hardwood cuttings that have partially matured and taken after the spring flush of growth; follow the protocols provided for semi-hardwood cuttings.
- Use a mix of 3 parts perlite to 1 part potting mix (3:1) in a shallow flat; treat the base of the cuttings with rooting powder No. 1 or Rootone® No. 3, which has a fungicide in it.
- For these cuttings it is best to put them in a mist system (scheduled from 6 AM to 6 PM).
- The cuttings should develop roots in three to five months; when they do, transplant and care for them the same as for your seedlings.

OUTPLANTING

- Your hō'awa will be ready for outplanting in one to two years or when they have outgrown a 1–2-gallon pot.
- Choose a site similar to the environment the seeds and cuttings were collected in; for instance, do not plant a wet forest species in a dry forest habitat.
- Amend the soil to be well-draining; also mix in small amounts of 8-8-8 NPK fertilizer.
- Plant with other plants such as ferns and ground covers; allow for plenty of room for your hō'awa to grow to their full potential.
- Water in your plants and then water weekly; monitor the soil for moisture level and water when it is dry until the plants are well established, indicated by new foliar growth.
- Add small amounts of 8-8-8 or 14-14-14 NPK fertilizer every four to six months.

PESTS

- Ants living at the base of hō'awa will weaken the roots, and they will farm mealybugs, aphids (which transmit viruses to your plant), and scales; control the insects with natural horticultural oils and use bait for the ants.
- Red spider mites are tiny red mites that live on the underside of leaves, sucking out the chlorophyll and causing the leaves to yellow and fall off with time. Spray under the leaves with water when watering, or rotate spray with horticultural oils (neem or mitecides).

P

PLANTAGINACEAE

(PLANTAIN FAMILY)

GENUS:

Plantago

HAWAIIAN NAMES:

Laukahi kuahiwi; manene; ale

COMMON NAME:

Hawaiian plantain

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. hawaiensis	E	end (H) dry to mesic forests
P. pachyphylla	—	end (K, O, Mo, M, H) wet forests to alpine grassland
P. princeps var. *anomal*		end (K, O)
P. princeps var. *laxiflora*		end (Mo, M, H) steep cliffs to base of waterfalls
P. princeps var. *longibracteata*		end (K, O)
P. princeps var. *princeps*		end (O)



***Plantago princeps* var. *anomala* seed spikes – Kaua'i — KRW**

Shady

Range
Hawaiian Endemic

Description
herb to shrub

Propagation
seeds

GENERAL DESCRIPTION

Native *Plantago* species are robust, perennial herbs to small shrubs growing terrestrially or sometimes epiphytically in wetter habitats. The pale to dark green foliage (sometimes densely woolly) grows up from the base of the plant in a rosette form, whereas *P. princeps* grows from 3–4 feet tall with long, weak, somewhat woody stems that often lean against other plants for support in the wet forests. Long flower spikes grow up from the base of the leaves with many tiny flowers, as do the small, mucilaginous seeds, which become slimy when wet and stick to passing birds. This is how the seeds were originally dispersed to the Hawaiian Islands. These plants are not as easy to grow and maintain as their weedy relatives. They need extra care to keep the many introduced insects away, and they do not grow well in lowland plantings.

Entire Range: Hawaiian endemic

Wild Habitat: Dry, mesic to wet forests, alpine grasslands, steep cliffs to the base of waterfalls

Habit: Robust to small perennial herbs or shrubs

Mature Height: 0.2 dm to 1.2 m

Stem/Trunk: Stems stout, woolly (red to brown); stems hollow (*P. princeps*) and branched

Leaves: Leaves simple, without stipules, basal and/or tufted near the tips; leaves leathery, narrow to oblong-elliptic

Inflorescence/Flower: Flowers occur on spikes, each flower with a single bract beneath it; they each have four sepals, with the lobes reflexed (the tips turning outward)

Fruit: Capsules occur on a persistent spike, and are oblong to ellipsoid

Seed: Seeds are small (1–2 mm), roundish, brown, yellowish-brown or black, mucilaginous with a well developed, and translucent endosperm (Wagner et al. 1990)



***Plantago pachyphylla* seed spikes – Kaua'i — KRW**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the spikes when they are browning and the seeds are shedding.
- Keep them dry in a paper bag for easy cleaning; follow the protocols for small dry seeds.
- The seeds can be stored in desiccation for up to seven years, or refrigerated.
- Soak the seeds in tap water for one to two hours, then sow them onto a dry mix of 3 parts perlite to 1 part potting mix (3:1).
- Cover seeds with ¼ inch of mix. Water them in, then water every other day.
- Keep them moist in a shaded, covered area.

GERMINATION

- All viable seeds will sprout in one to four months; wait until four to six true leaves develop.
- Carefully transplant the seedlings into 2-inch pots filled with a mix of 3 parts black cinder to 1 part potting mix (3:1) or one of the other well-draining mixes and follow the recommendations.
- Keep the potted seedlings in a shaded area with plenty of ventilation to reduce bug infestations.
- The young plants are susceptible to attacks from thrips and aphids, which deform the foliage. To treat this, apply a systemic pesticide added to the mix.
- Repot them into larger pots and add new media about every four months, when the plants' roots fill the bottom of the pots.
- Keep them in partial shade for best results.



***Plantago princeps* var. *anomala* seedlings – NTGB nursery — DR**

OUTPLANTING

- Your *Plantago* will be ready to outplant when it has outgrown a 6-inch pot, which will be in about six months to a year.
- Choose a site in the shade with well-draining soil, or amend the soil to create a well-draining area.
- Plant it under or with other plants such as shrubs, small trees, or in a hāpu'u fern trunk (*P. pachyphylla*).
- Water them in, then water when it is dry; monitor your plants closely for insects and slugs.
- These plants are short-lived, but they will produce plenty of seeds that will regenerate in time.

PESTS

- Aphids and other sucking insects can deform the leaf growth when they attack. To treat them, apply a systemic pesticide or spray with horticultural oil.

P

PLUMBAGINACEAE

(PLUMBAGO OR LEADWORT FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Plumbago	**'Ilie'e, hilie'e**	*P. zeylanica*	—	ind (KL, HI)



***Plumbago zeylanica* flowers – Kaua'i — KJ**

Full Sun – Partial Sun

Range
Indigenous

Description
ground cover to sprawling shrub

Propagation
seeds and cuttings

GENERAL DESCRIPTION

'Ilie'e is a sprawling shrub with smooth bright green ovate leaves, occurring in dry arid forests and shrubland. The pale, whitish-blue flowers form at the tips of the branches. Long tacky seed capsules develop along the spikes and can easily get attached to shore bird feathers as they pass through vegetation. The Hawaiians used the juice from the roots for medicinal purposes as well as to make a black dye for tattooing (Neal 1965). This is a very easy plant to propagate and maintain as a ground cover in drier environments. It even takes over other low-growing plants that are growing nearby; give this plant room to spread out. It tolerates heavy pruning and roots into the ground at its nodes, holding itself down. A strong ground cover, ideal for stabilizing soil erosion.

Entire Range: Indigenous to Old World tropics and Hawai'i
Wild Habitat: Arid, disturbed areas, sand dunes, dry forests, and shrublands
Habit: Sprawling shrub
Mature Height: 0.5–2.5 m long
Stem/Trunk: Stems up to 2.5 m long
Leaves: Leaves are oval with a pointed tip, both leaf surfaces are smooth, without hairs or glands; each leaf stalk is about 1 cm long
Inflorescence/Flower: The flowers occur in racemes about 20 cm long; each flower is white with blue to purple anthers, with a floral tube and with flower parts in multiples of five
Fruit: The fruit is a membranous, oblong capsule, about 5 mm long and smooth
Seed: The seeds are dark purplish-brown, about 4 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seeds, first collect the long tacky capsules when they are browning and shedding from the stems.
- Keep them dry in a paper bag for easy cleaning.
- Separate the brownish seeds from the capsules and follow the directions for small dry seeds.
- Start the seeds fresh for best germination results.
- Soak them in tap water for one hour, or do not use any pretreatment. Either way, they will still sprout.
- Sow them into a mix of 3 parts perlite to 1 part potting mix (3:1) and cover the seeds with ½ inch of mix, then water them in.
- Keep the seed flats in a covered area, protected from heavy rains.
- Water them weekly and when they dry out, but do not allow the flats to dry out completely.

GERMINATION

- All of your viable seeds will germinate in about one to four months.
- Wait until at least four true leaves develop, then transplant them into 2-4-inch pots with a well-draining mix.
- Amend the mix by adding more perlite or more cinder to increase the drainage.
- Keep the seedlings in the shade for a few weeks, then move them into more sun.
- Repot them into larger pots when they have outgrown their pots, in about three months.
- The plants need to be hardened off in full sun to prepare them for outplanting.
- Foliar feed them monthly.

CUTTINGS

- To propagate clonally, collect semi-hardwood cuttings from the mature stems and follow the protocols for semi-hardwood cuttings.
- Reduce or remove all of the foliage and the very tips of the stems (they are too green).
- Keep them moist at all times in a sealed plastic bag until you are ready to start them.
- Cut them into 4–5-inch pieces with at least three nodes each. Keep track of which end is up.
- Apply rooting powder No. 1 for green stems, and rooting powder No. 3 for woodier stems.
- Stick the bottom ends 1 inch into a premoistened cutting mix with at least one node under the mix. Use a mix of 3 parts perlite to 1 part vermiculite (3:1).
- Water them in lightly to settle the cuttings, and be careful not to wash off all of the rooting powder
- Keep them moist in a covered area.
- They should be rooted in two to four months. Foliar feed the cuttings after they have leafed out. Transplant and handle them the same as the seedlings.



***Plumbago zeylanica* cuttings – NTBG nursery — KLR**

OUTPLANTING

- Your plants will be ready for outplanting in about six months or when they have outgrown a 4-inch to 1-gallon.
- These ground covers will tolerate partial shade as an understory plant, or they can be planted in full sun.
- Amend the soil for good drainage as recommended.
- Water in the plants, then water only when it is dry.
- Apply 8-8-8 or 10-10-10 NPK fertilizer every four to six months, and work it into the soil if they are growing poorly.

PESTS

- Ants living at the base of 'ilie'e will weaken the roots, and they will farm mealybugs, aphids (which transmit viruses to your plant), and scales; control the insects with natural horticultural oils and use bait for the ants.
- Slugs can infest the plant if they live among the plant and feed on its leaves. If this happens, apply slug bait as directed.
- Chinese rose beetles eat holes in leaves; place a solar night light near by or apply a systemic pesticide worked into the soil and then watered in.

POACEAE
(GRASS FAMILY)

Nineteen genera, comprised of forty endemic and eight indigenous species.

Full Sun – Partial Sun[1]

Range
Endemic or Indigenous[2]

Description
perennials or annuals

Propagation
seeds and cuttings

1: Sun requirements differ for each species.

2: Range differs for each species.

GENUS: ***Agrostis*** COMMON NAME: **Bentgrass**

SPECIES	STATUS	HAWAIIAN RANGE
A. sandwicensis	—	end (K, O?, M, H)

GENUS: ***Calamagrostis*** COMMON NAME: **Reedgrass**

SPECIES	STATUS	HAWAIIAN RANGE
C. espansa		end (M, H)
C. hillebrandii		end (Mo?, M)

GENUS: ***Cenchrus*** COMMON NAME: **Sandbur**

SPECIES	STATUS	HAWAIIAN RANGE
C. agrimonioides var. *agrimonioides*		end (O, L, M)
C. agrimonioides var. *laysanensis*		end (NWHI)

GENUS: ***Chrysopogon*** COMMON NAME: **Golden beardgrass**

SPECIES	STATUS	HAWAIIAN RANGE
C. aciculatus		ind (HI exc. Ni, Ka)

GENUS: ***Deschampsia*** COMMON NAME: **Hairgrass**

SPECIES	STATUS	HAWAIIAN RANGE
D. nubigena		end (K, Mo, M, H)

GENUS: ***Dichanthelium***

SPECIES	STATUS	HAWAIIAN RANGE
D. cynodon		end (K, O, Mo, M)
D. hillebrandianum		end (K, O, Mo, M, H)
D. isachnoides		end (K, Mo, M)
D. koolauense		end (O, M)

GENUS: ***Digitaria*** COMMON NAME: **Grabgrass**
HAWAIIAN NAME: **Kūkaepua'a**

SPECIES	STATUS	HAWAIIAN RANGE
D. setigera	—	ind (HI exc. Ka)

GENUS: ***Dissochondrus***

SPECIES	STATUS	HAWAIIAN RANGE
D. biflorus	R	end (HI exc. Ni, Ka)

GENUS: ***Eragrostis*** COMMON NAME: **Lovegrass**

SPECIES	STATUS	HAWAIIAN RANGE
E. atropioides		end (O, Mo, L, M, H)
E. deflexa		end (Mo, L, M, H)
E. fosbergii		end (O)
E. grandis		end (HI exc. Ni)
E. leptophylla		end (L, M, Ka, H)
E. mauiensis		end (L, M)
E. monticola		end (Mo, L, M, H)
E. paupera		end (O)
E. variabilis		end (HI)

GENUS: ***Festuca*** COMMON NAME: **Fescue**

SPECIES	STATUS	HAWAIIAN RANGE
F. aloha		end (K)
F. hawaiiensis		end? (M?, H)
F. molokaiensis		end (Mo)

GENUS: ***Heteropogon*** COMMON NAME: **Pili grass**

SPECIES	STATUS	HAWAIIAN RANGE
H. contortus		ind? (Le, HI)

GENUS: ***Isachne*** HAWAIIAN NAME: **'Ohe**

SPECIES	STATUS	HAWAIIAN RANGE
I. distichophylla		end (HI exc. Ni, Ka)
I. pallens		end (K, O)

GENUS: ***Isachaemum*** COMMON NAME: **Hilo ischaemum**

SPECIES	STATUS	HAWAIIAN RANGE
I. byrone	V	end (K, O, Mo, M, H)

GENUS: ***Lachnagrostis*** (syn. *Agrostis avenacea*)

SPECIES	STATUS	HAWAIIAN RANGE
L. filiformi	—	ind (HI exc. Ni)

GENUS:
Lepturus

SPECIES	STATUS	HAWAIIAN RANGE
L. repens	—	ind (Le?)

GENUS:
Panicum
COMMON NAME:
Panic grass

SPECIES	STATUS	HAWAIIAN RANGE
fourteen emdemic species		end (HI, KL, Le)

GENUS:
Paspalum
COMMON NAME:
Rice grass

SPECIES	STATUS	HAWAIIAN RANGE
P. scrobiculatum	—	ind? (K, O, Mo, M, H)

GENUS:
Poa
COMMON NAME:
Bluegrass

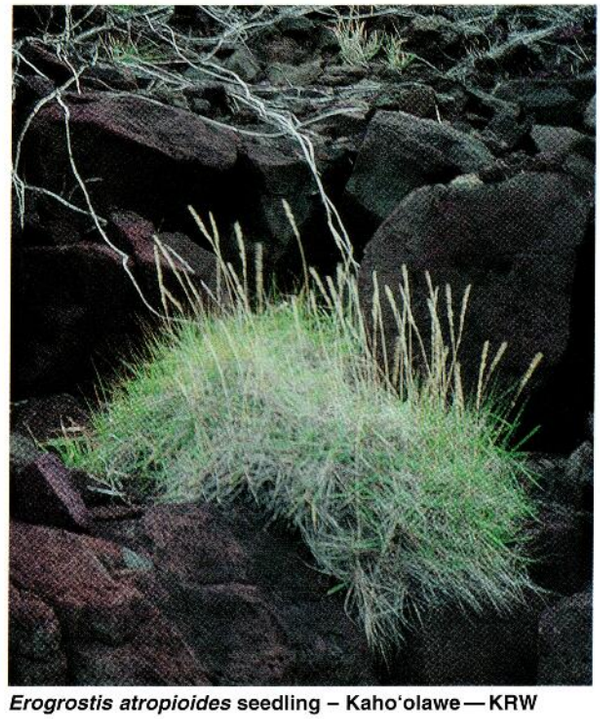
SPECIES	STATUS	HAWAIIAN RANGE
P. mannii	E	end (K)
P. sandvicensis	E	end (K)
P. siphonoglossa	E	end (K)

GENUS:
Sporobolus
COMMON NAME:
Beach Dropseed
HAWAIIAN NAME:
'Aki'aki

SPECIES	STATUS	HAWAIIAN RANGE
S. virginicus		ind (HI)

GENUS:
Trisetum
COMMON AND HAWAIIAN NAME:
Mountain pili; pili uka; he'upueo

SPECIES	STATUS	HAWAIIAN RANGE
S. glomeratum		end (M, H)
S. inaequale		end (L, M)



***Erogrostis atropioides* seedling – Kaho'olawe — KRW**

GENERAL DESCRIPTION

The grass family is the most widely distributed and most important human food source in the world. It is one of the five largest families of flowering plants, and is even well represented in the Hawaiian Archipelago where grasses occur from the coast to the mountains as perennials or annuals with woody fibrous to rhizomatous root systems. The flowers and seeds grow high above the foliage, which aids self-pollination or wind pollination. The abundant seeds are easily dispersed by birds, and are very adaptable to the different environments. Hawaiians used the different grasses for thatching, cordage, animal forage, medicine, and offerings to the gods. If you would like more information, or would like to identify native Hawaiian grasses, refer to the *Manual of the Flowering Plants of Hawai'i* (Wagner et al. 1990). This is an excellent reference as a floral key, with descriptions and drawings of the plants. Most of the native grasses are fairly easy to grow (from seeds or division) and maintain in the landscape. When they are planted out, they make plenty of seeds and regenerate themselves readily. *Eragrostis*, *Ischaemum*, and *Panicum* from high elevations do well at lower elevation outplanting sites when given the proper care. For the more threatened species, such as *Poa*, seeds are not always viable if they are from small, isolated populations. Grasses from wetter habitats seem to need a little more care.

Entire Range: Indigenous and endemic Hawaiian species



***Poa mannii* flowers – Kaua'i — DL**

Wild Habitat: Diverse plants, which occur from coastal habitats, disturbed areas, dry, mesic, to wet forests and the margins of bogs

Habit: Annual to perennial herbaceous monocots

Mature Height: Diverse, from 5 cm to 4 m tall

Stem/Trunk: Herbaceous solitary stems with nodes and internodes, often clumping at the base

Leaves: Leaves are alternate, arranged in 2-ranks in opposite rows, or spirally arranged; parallel veined; usually a ligule at the junction of the leaf blade and the sheath; leaf margins usually entire

Inflorescence/Flower: Flowers perfect, or rarely unisexual, wind or self-pollinating, spikelets arranged in panicles, racemes, spikes, or flower heads; flower parts in multiples of three, with a superior ovary

Fruit: Fruit is a grain (*caryopsis*)

Seed: Seeds usually have abundant endosperm and are dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

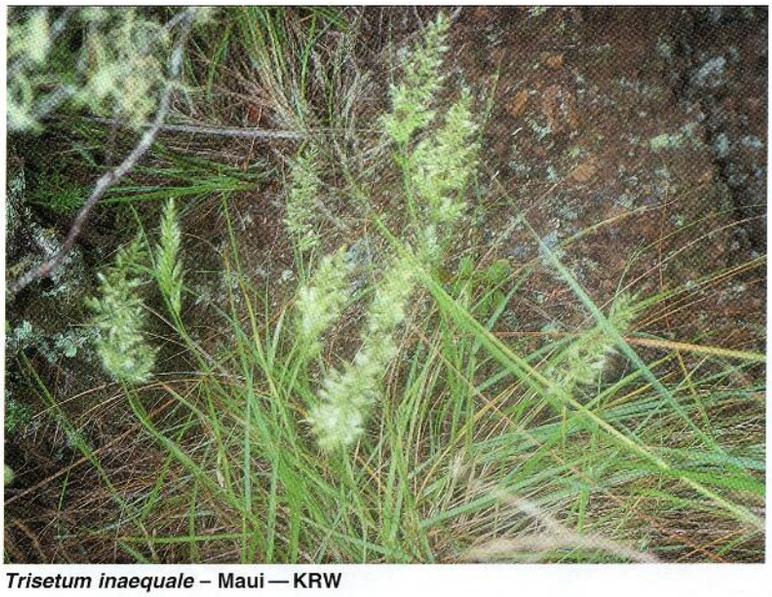
- To propagate by seed, first collect the fruits when they are dry and browning. A good indicator of when they are mature is when they are shedding from the plant.
- Keep them dry in a paper bag until cleaning.
- Separate the seeds from the fruits as recommended for small dry seeds.
- The cleaned seeds can be stored in desiccation chambers for up to ten years without losing much viability or refrigerate dry.
- No seed pretreatments are necessary.
- Surface sow the seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1) or on fine black cinder.
- Water the seeds in, and then water every other day.
- Keep them in a covered area, protected from heavy rains and wind.
- Once the seedlings sprout, feed them with a light solution of foliar feed monthly.

GERMINATION (fast-growing grasses)

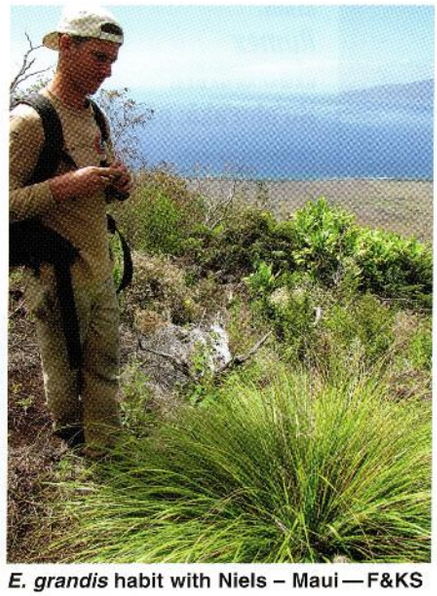
- All of your viable native grass seeds will germinate in two weeks to four months.
- Wait until four to six leaf blades develop before transplanting them into 2–4-inch pots (depending on the size of the root ball).
- Use a well-draining mix with small amounts of 8-8-8 NPK fertilizer.
- Keep your seedlings in the shade for a few weeks, then move them into partial sun.
- Repot them into larger pots and add new mix when the roots fill the pots; foliar feed them monthly.
- Move plants into an area with partial to full sun to help harden them off and prepare them for outplanting.

CUTTINGS (rhizome division)

- To clonally propagate your native grasses, first dig under the plant slightly to expose the roots.
- Remove 4–5-inch pieces of rhizome and cut the top foliage in half, keep the material moist in a sealed plastic bag until planting.
- No rooting powders are needed.



Trisetum inaequale – Maui — KRW



E. grandis habit with Niels – Maui — F&KS

- Pot them into pots filled with a mix of 3 parts perlite to 1 part potting mix (3:1) or in fine black cinder.
- Place the rhizome/root pieces just below the surface.
- Water them in, then water every other day, keeping them in a shaded, covered area.
- They will root in two to four months. Foliar feed them monthly for stronger growth.
- Repot them into larger pots and add new mix every three months or so for the faster growing grasses, and every six months for the slower, threatened species.

OUTPLANTING

- Your grasses will be ready for outplanting in about six months to one year, when they have outgrown a 6-inch to 1-gallon pot.
- Choose a site that mimics the environment the seeds were collected from (moist or dry). Trees and shrubs can provide shade and help maintain extra moisture. Plant grasses that need drier conditions in full sun.
- Amend the soil for good drainage as directed, and use small amounts of 8-8-8 NPK fertilizer.
- Water in the grasses, then water them when it is dry until they are established and are producing new growth.
- Allow room for the grasses to grow; do not crowd them in with other low-growing plants.
- When they mature, their seeds will fall to the ground and regenerate themselves. Some of the annual grasses usually die back after flowering and seeding. To prevent this and prolong the plant's life, remove the flower heads before they go to seed.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your native grasses; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them, and bait for the ants according to the protocols for ants.

P

POLYGONACEAE

(BUCKWHEAT FAMILY)

GENUS:

Rumex

HAWAIIAN NAMES:

Huʻahuʻakō; pāwale; uhauhakō

COMMON NAMES:

Sorrel; dock

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
R. albescens	—	end (K, O) dry shrubland to mesic forest
R. giganteus	—	end (Mo, M, H) mesic, wet forests, and subalpine
R. skottsbergii	—	end (H) dry lava flows

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds



***Rumex skottsbergii* seeds – Hawai'i — DL**

GENERAL DESCRIPTION

The native *Rumex* occurs as sprawling shrubs to small subshrubs, with orange-brown stems that sometimes grow along the ground. In the lower, drier elevations the plants are smaller and less hairy; higher, wetter habitats produce larger plants (*R. giganteus*). The pointed, oval-shaped leaves come in several shapes and sizes, with or without hairs. Both male and female flowers occur on the same plant (monoecious), and are greenish-yellow to red, growing on spikes at the branch ends above the foliage. They later develop into clusters of small, orangish fruits. The small-rimmed nuts (seeds) are pale brown and wind dispersed for shorter distances. However, *Rumex* is believed to have arrived in the Hawaiian Islands carried by birds.

Entire Range: Hawaiian endemic

Wild Habitat: Dry lava flows and ash to dry shrublands, mesic, wet to subalpine forests

Habit: Shrub, subshrub, scandent shrub or liana

Mature Height: 0.3–200 dm

Stem/Trunk: Decumbent stems smooth to hairy (*R. albescens*); decumbent, sub-erect to sprawling, smooth to hairy (*R. giganteus*); stems usually stiffly erect and smooth (*R. skottsbergii*)



***R. giganteus* habitat – Maui — F&KS**

Leaves: Leaves are flat to undulate, thin to thick, large oval and narrowing to a pointed tip

Inflorescence/Flower: The flowers are unisexual and the plants are monoecious (both male and female flowers on the same plant); the flower parts are in multiples of three, occurring on paniculate inflorescences; flowers can be greenish, yellow to reddish and are small

Fruit: The fruit is a three-angled brown nut

Seed: Seeds are small and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS (easy)

- To propagate by seed, first collect the fruits when they are browning and shedding from the plant; keep them dry in a paper bag until they are cleaned.
- Separate the seeds as directed for small dry seeds.
- The seeds can be stored in the refrigerator or in desiccation for up to eight years, losing some viability (*R. albescens*).
- Soak the seeds in tap water for twenty-four hours. Then surface sow them onto a dry mix made up of 3 parts perlite or 3 parts small black cinder to 1 part potting mix (3:1), and water them in.
- Keep the flats in a covered area, protected from heavy rains.
- Once the seedlings begin to sprout, foliar feed them monthly with a light fertilizing solution.

GERMINATION

- Germination of all viable seeds will occur in about one to three months.
- Wait until at least four true leaves develop, then transplant them into 2-4-inch pots of well-draining mix.
- Use a mix of 2–3 parts black cinder to 1 part potting mix (3:1), or other well-draining mixes; add small amounts of 8-8-8 NPK fertilizer.
- Keep them in the shade for a few weeks, and then move them into partial sun.
- These plants are fast-growing, and you will need to repot them into larger pots and add new mix when they grow twice as tall as their pots (in a few months).
- Move them into partial to full sun to harden them off and prepare them for outplanting.
- Foliar feed them monthly.
- *Rumex* look better and last longer in a pot if you cut off all of the flowers.

OUTPLANTING

- Your dock will be ready for outplanting in about six months, when it has outgrown a 4–6-inch pot.
- Choose a site suited to its natural environment (dry-sunny or shady-moist).
- Amend the site with cinder for well-draining soil; add small amount of 8-8-8 NPK fertilizer.
- Water them in, then water when it is dry until they are established
- *Rumex* would look attractive in a black cinder mound garden where they would also thrive.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your native *Rumex*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

P

PORTULACACEAE

(PURSLANE FAMILY)

GENUS:

Portulaca

HAWAIIAN NAMES:

'Ihi; po'e

SPECIES	STATUS	HAWAIIAN RANGE
P. lutea	—	ind (KI, HI exc. O, Ka)
P. molokiniensis	R	end (M, Ka)
P. sclerocarpa	E	end (L, H)
P. villosa	V	end (HI exc. Ni, K)



***Portulaca molokiniensis* flowers — DR**



***Portulaca villosa* – Maui —F&KS**

Full Sun

Range
Endemic or Indigenous[1]

Description
herb

Propagation
seeds and cuttings

1: Range differs for each species.

GENERAL DESCRIPTION

The small, charming 'ihi are succulent perennial herbs with small, tuberous roots. They grow as low, spreading mats or clumps, with thin to thick fleshy stems and leaves. They're found in the most uninhabitable terrains in the islands such as rocky sea cliffs to dry subalpine woodlands or near volcanic steam vents (*P. sclerocarpa*). It is believed that native *Portulaca* arrived to the Hawaiian Islands by ocean flotation, surviving long distances exposed to seawater, stems, leaves and seeds float. (Carlquist 1980). Their arrival was the result of two separate colonization events: *P. lutea* and *P. molokiniensis* as the first, and *P. sclerocarpa* and *P. villosa* as another (Wagner 1990). The latter are smaller plants, with pale grayish-green leaves, thinner stems, and pinkish-white flowers; the first two are taller plants with larger yellow flowers, thicker stems, and greener leaves. The small round seed capsules cluster at the branch ends. They turn brown and crack open when they mature, and the capsules contain many tiny dark brown seeds. These small plants make good container plants. Treat them like a succulent, allowing the soil to dry out in between watering. Use straight black cinder or add a small amount of potting mix to it (3 parts cinder to 1 part potting mix), or outplant them into a cinder mound. The foliage and flowers are very attractive against the black cinder.

Entire Range: Endemic to all of the main Hawaiian Islands and one species indigenous (*P. lutea*) occurring throughout the Pacific and Hawai'i

Wild Habitat: Coastal, strand, sand dunes, sea cliffs, volcanic areas, dry habitats, and coralline reef sites

Habit: Perennial herb

Mature Height: 0.5–3 dm long

Stem/Trunk: Stout, herbaceous to fleshy

Leaves: Leaves simple, alternate, opposite to clustering, succulent, with margins entire; can be narrow and linear to flat and egg-shaped with the broadest portion near the leaf tip; leaf axils with tufts of hair.

Inflorescence/Flower: Flowers in terminal cymes, or sessile; petals five and yellow, white, or pink; twelve to eighty stamens; ovary partially inferior

Fruit: Membranous capsules

Seed: Small brown seeds (Wagner et al. 1990)

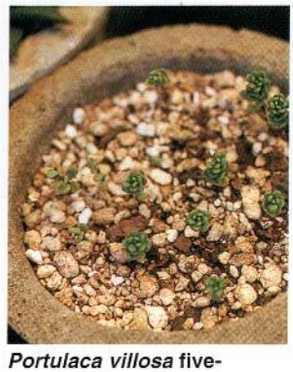
PROPAGATION AND CULTIVATION

SEEDS (easy)

- To start your plants by seed, first collect the capsules when they are dry and browning. Keep them dry in a paper bag until cleaning.
- Separate the small brown seeds as recommended for small dry seeds.
- The seeds do tolerate storage and can be desiccated or refrigerated for up to seven years.
- In a shallow flat, surface sow the tiny seeds on dry 3 parts perlite to 1 part potting mix (3:1) or on fine black cinder; water in.
- Keep in a covered area to control moisture from rains, water every two days, keep somewhat dry.
- Once seedlings start to develop two true leaves, begin to foliar feed monthly with a light solution (use half of what is recommended). **Note**: fertilizers can easily burn these sensitive plants.

GERMINATION

- Germination of all viable seeds will take about two weeks to three months; wait until four true leaves develop.
- Once at least four true leaves have developed, transplant your seedlings into a 1–2-inch pots with a mix of 4 parts black cinder to 1 part potting mix (4:1) or 3 parts perlite to 1 part potting mix (3:1).



Portulaca villosa **five-month-old seedlings – NTBG nursery — KRL**

- Keep the seedlings in a covered area with sun; try to control the amount of moisture the plants get, keep them on the dry side to prevent rot.
- Repot them when the roots fill the bottom of the pot (but do not wait until they are root-bound); this should take about three to five months. Add a small amount of 8-8-8 NPK fertilizer to the mix.
- Move them into full sun to harden them off and prepare them for outplanting. Or leave them in a clay or cement pot as a display plant, repotting and changing the mix yearly.

CUTTINGS

- To clonally propagate your *Portulaca*, collect fresh herbaceous stem cuttings 3–5 inches long; keep them in a sealed plastic bag until started, but no longer than a few days. Follow the directions for herbaceous stem cuttings.
- No rooting powders are necessary; care for them the same as for the seedlings, using the same mix.
- Your cuttings should be rooted in two weeks to one month; transplant and care for them the same as for the seedlings.

OUTPLANTING

- Your plants will be ready for outplanting in about six months or when they have outgrown 4–6-inch pots.
- It is important to choose a site in full sun with very well-draining soil; amend the site with small cinder or gravel and add a small amount of 8-8-8 NPK fertilizer worked into the soil.
- Water the plants in initially, then monitor them weekly for dryness or poor drainage. Treat these plants like other succulents, allowing them to dry out between watering. The plants can succumb to fungal rot caused by too much moisture, such as overwatering, and poor drainage.

PESTS

- Slugs will eat your plants at any stage of development; to avoid them, keep the area treated with slug bait.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your native *Portulaca*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Root mealybugs are tiny white bugs in the root area; control them with a systemic pesticide.
- Scales may take up residence along the plant stems; they can be controlled with systemic pesticides as recommended.

P

PRIMULACEAE

(PRIMROSE FAMILY)

GENUS:

Lysimachia

HAWAIIAN NAME:

Kolokolo kuahiwi

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
L. daphnoides	R	end (K) bogs
L. filifolia	E	end (K, O) wet areas
L. forbesii	Ex/E	end (O) wet forest
L. glutinosa	—	end (K) mesic forest
L. hillebrandii	—	end (K, O, Mo, L, M) mesic to wet forests
L. iniki	R	end (K) mesic forest
L. kalalauensis	R	end (K) shaded mesic forests
L. lydgatei	E	end (M) wet gulches
L. mauritiana	—	ind (HI) coastal
L. maxima	E	end (Mo) wet forests
L. pendens	E	end (K) mesic forests, bogs
L. remyi	—	end (Mo, M) mesic, wet, and subalpine
L. scopulensis	E	end (K) mesic, wet forests
L. venosa	E	end (K) wet forests

Sun Requirements
Species specific

Range
Endemic or Indigenous[1]

Description
perennial herb, shrub or subshrub

Propagation
seeds and cuttings

1: Range differs for each species.



***Lysimachia hillebrandii* flowers – O'ahu — KRW**



***Lysimachia filifolia* flowers – O'ahu — SP**

GENERAL DESCRIPTION

The Hawaiian primroses occur naturally as small, sprawling, shallow-rooted shrubs in moist, wet habitats (except for the coastal *L. mauritiana*). They have alternate leaves, which are round to narrow with spotted glands, forming in large numbers along the stems or closely whorled at the ends. Small singular, white to reddish-purple, bell-shaped flowers hang from the leaf axils. The round woody capsules contain many tiny black irregularly shaped seeds that germinate easily if they are viable. Some of these species are so threatened and isolated that inbreeding has weakened the species, which can make successful propagation quite a challenge. In general they are slow-growing except for the indigenous species *L. mauritiana*, which is the easiest to grow and maintain in a dry landscape.

Entire Range: One indigenous species (*L. mauritiana*), thirteen Hawaiian endemic species

Wild Habitat: Coastal, shaded, mesic to wet forests, gulches and bogs

Habit: Erect, ascending, or prostrate perennial herbs; shrubs or subshrubs

Mature Height: Variable

Stem/Trunk: The stems do not root at the nodes; the stems are herbaceous to woody

Leaves: The leaves are opposite, alternate, whirled, or arranged in threes; the leaves have glandular dots; either have leaf stalks or are without leaf stalks

Inflorescence/Flower: Flowers are attractive; solitary in axils or in racemes, the calyx is five to ten lobed, corolla yellow, white, purple, reddish-purple, or green



***Lysimachia* species flowers — KM**

Fruit: Capsules, which are thick and hard, dehiscent by valves or irregularly dehiscent

Seed: Small black, dry, irregularly shaped seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are browning and starting to split open.
- Keep the seeds dry in a paper bag until cleaned.
- Separate the seeds as recommended for small dry seeds.
- Start the seeds fresh because storage depletes the viability.
- Soak them in tap water for thirty minutes to one hour; they will germinate with no pretreatments, but it will take longer.
- Surface sow them onto a mix of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1) in shallow flat; water them in.
- Keep the seed flat in a shaded, covered area, kept moist by watering every other day.
- Once the seedlings sprout, foliar feed them monthly with a light fertilizer solution.

GERMINATION (slow-growing)

- All viable seeds will germinate in one to six months.
- Before transplanting, wait until four true leaves develop.
- Then transplant into 2-inch pots of well-draining cinder mix as recommended.
- Keep them in a shaded area, protected from heavy rains and strong winds.
- Continue to foliar feed them monthly, with a light solution
- Move them into partial shade to help harden them off and prepare them for outplanting or leave the plants in shallow pots.

CUTTINGS

- I recommend propagating these plants from seed, except for *L. mauritiana*, which is common and easy to grow.
- Collect and follow the protocols for softwood cuttings; do not allow the material to dry out at any time.
- Apply rooting powder No. 1 or do not use any rooting powder at all; either way, they will all still take root.
- At this stage, follow the directions given for seedling care and handling. *L. mauritiana* needs full sun to help harden it off and prepare it for outplanting.

OUTPLANTING

- To keep your *Lysimachia* as a container plant, repot it annually and at the same time replace the mix with new mix; add 8-8-8 NPK fertilizer.
- To outplant, it may take one to two years for endemic species and six months for the indigenous species.
- Choose a site that is most like the plant's native habitat, such as dry-coastal to shady-moist or bog.
- Amend the site accordingly and add small amounts of 8-8-8 NPK fertilizer to the soil.
- Water the plants in, and then monitor them weekly, watering when it is dry until they are well established. Foliar feed them monthly.
- For the threatened, more sensitive endemic species, outplant them among other plants such as larger shrubs or ferns, which will provide protection. Make sure to allow each plant enough room to grow.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your native *Lysimachia*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RANUNCULACEAE

(BUTTERCUP FAMILY)

GENUS:

Ranunculus

HAWAIIAN NAMES:

Makou; ʻawa Kanaloa

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
R. hawaiensis	E	end (M, H) mesic forests
R. mauiensis	E	end (K, O, Mo, M, H) wet forests

Full Sun–Partial Sun

Range
Hawaiian Endemic

Description
herb

Propagation
seeds



Ranunculus mauiensis **flowers – Kauaʻi — SP**

GENERAL DESCRIPTION

The native buttercup, makou, are small, erect perennial herbs with fibrous roots. They occur in open mesic grassland to wet forests along streams. They grow curving upwards from the base; the stems, leaves, and flower parts are densely pubescent with whitish golden hairs. Small five-petaled, glossy yellow flowers develop on the tip of long spikes above the foliage; they are somewhat like the mainland buttercups. Numerous small, dry, rounded achenes (fruits) form on the spikes, each containing one seed. This is an easy, fast-growing herb to grow and maintain in the landscape. These plants will last longer if you remove the flower heads as they develop. Once they are planted out, the seeds will regenerate readily before dying back.

Entire Range: Endemic to all of the main Hawaiian Islands except Kaho'olawe and Ni'ihau

Wild Habitat: Mesic and wet forests

Habit: An erect perennial herb

Mature Height: 5–20 dm in height

Stem/Trunk: The stems are sparsely to densely covered with hairs; the plant has fibrous roots

Leaves: Basal leaves that are arranged in threes and compound, leaflets toothed, the terminal leaflet is usually the largest; the leaves are covered with hairs

Inflorescence/Flower: Flower parts in multiples of five; five yellow, curved petals glossy on the upper surface, five sepals 4–8 mm long; flowers in branched cymes

Fruit: Fruit, achenes are numerous, with a narrow wing and beaked (*R. hawaiensis*); achene with a slight margin and beaked (*R. mauiensis*)

Seed: Small dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the achenes (fruits) when they brown and dry; keep them dry in a paper bag until they are cleaned.
- Separate the seeds from the achenes as recommended for small dry seeds.
- Start the seeds fresh for best germination results.
- Soak the seeds in hand-hot or tap water for twenty-four hours; the viable seeds should sink; discard the seeds that float.
- Surface sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), then water them in.
- Keep the flats in a shaded, covered area, watering every other day to keep them moist.
- Once the seedlings sprout, with a light solution foliar feed them monthly.

GERMINATION

- Germination of all viable seeds will take one to six months; wait until four true leaves develop.
- Once at least four true leaves have developed, transplant your seedlings into 2- 4- inch pots using a well-draining mix made of 3 parts black cinder to 1 part potting mix (3:1), and add small amounts of 8-8-8 NPK fertilizer.
- Keep the seedlings in a shaded area; repot them into 4- 6- inch when they are twice as tall as their pots.
- Move them to partial sun (*R. mauiensis*) and full sun for (*R. hawaiensis*) allowing them to harden off to prepare them for outplanting.
- Foliar feed them monthly, and cut off any flowers before you outplant to strengthen the plants.

OUTPLANTING

- To outplant, choose a site with well-draining soil; amend the site as recommended.
- Plant out in partial sun (*R. mauiensis*); to full sun (*R. hawaiensis*); plant with other plants, for example, under trees, shrubs, or with ferns for extra protection.
- Apply small amounts of 8-8-8 NPK fertilizer about every three months.
- If your makou has been outplanted properly, it will continue to regenerate, producing many seeds.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your native makou; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

R

RHAMNACEAE

(BUCKTHORN FAMILY)

GENUS:	HAWAIIAN NAMES:	SPECIES	STATUS	HAWAIIAN RANGE
Alphitonia	**Kauila, kauwila; o'a**	*A. ponderosa*	R	end (HI exc. Ni, Ka)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Alphitonia ponderosa* green seeds – Kaua'i — KRW**

GENERAL DESCRIPTION

Kauwila trees occur in dry to mesic forests found more commonly on Kaua'i. They can reach 80 feet in height under ideal situations. The thin, leathery, alternate leaves are 6 inches long. The leaves are dark green and glossy on the upper surface and grayish or rusty-woolly underneath, more so when young. Small, pointed, star-shaped, greenish flowers develop from the leaf axils near the branch ends. The black woody fruits are round, containing two brownish seeds. The beautiful hardwood is reddish-brown with black streaks and is very dense (it sinks in water). The Hawaiians found kauila to be a very useful wood for hardwood tools, spears, kala'au sticks (which were used to beat in time to a chant or dance), and for carving Hawaiian gods and figurines (Abbott 1992). Kauila is a fairly easy tree to germinate and maintain in the landscape. The seeds need pretreatment to hasten germination. I have noticed that the seed viability is higher in wetter years than drought years.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Trees
Mature Height: 4–25 m
Stem/Trunk: Bark whitish and deeply corrugated in drier habitats

Leaves: Leaves alternate, leathery, nerved pinnately, upper leaf surface dark green, underside of leaf covered with a reddish tomentum; leaf margins entire; leaf about 12 cm long by 5 cm wide with a long leaf stalk

Inflorescence/Flower: Flowers small, perfect, flower parts in multiples of five, with five sepals, five petals, five stamens, a nectary disc, and a partially inferior ovary

Fruit: The fruits are partly enclosed by the floral tube and nectary disc, creating a wrinkled surface; they are round, woody, brown and about 16 mm in diameter; the fruit are indehiscent or late in dehiscing

Seed: Brown seeds covered with a red aril, oblong, about 6 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Alphtonia ponderosa* ripe seeds – NTBG — DR**

- To propagate by seeds, first collect the fruit when it is blackish-brown and shedding from the tree; keep it dry in a paper bag.
- Remove the hard outer seed coat with a hammer and anvil, be careful not to damage the seeds.
- Start the seeds fresh; storage tolerance has not been tested.
- Scarify the seeds with clippers as recommended in the protocols, and the germination results will be faster and more successful.
- Or soak the seeds in hand-hot or tap water for forty-eight hours. You can soak then scar the seeds, but never scar the seed first, then soak it in water, because the seeds will take in the water too fast, killing the embryos.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) and then cover the seeds with ½ inches of additional mix.
- Water the seeds in.
- Keep the flats in a shaded, covered area and water every other day to keep them moist.

GERMINATION

- Germination of all viable seeds will take three weeks to three months; scarified seeds sprout more uniformly than soaked seeds.
- Wait until four true leaves develop, in another month, before transplanting.
- Transplant into 2–4-inch pots depending on root-ball size, and foliar feed them monthly with a light solution.
- Keep the seedlings in a shaded area, repotting them every six months into taller pots for healthy root formation and growth.
- Continue to foliar feed them monthly; move them into full sun to harden them off to prepare them for outplanting.

OUTPLANTING (slow-growing trees)



***Alphitonia ponderosa* seedlings – NTBG nursery — KLR**

- Your trees will be ready for outplanting after one to two years, when they have outgrown a 1–2-gallon pot.
- Choose a site with full to partial sun. It is important that the soil is amended for good drainage; add small amounts of 8-8-8 NPK fertilizer every three to six months, depending on the rainfall.
- Water them in, and then monitor them for soil moisture, watering when it is dry.
- Foliar feed them monthly for faster growth.
- Outplant at the same depth as the plant was in the pot, making sure the tree does not sink down into the hole. Covering up the bottom of the young tree trunk can kill the tree.
- These striking trees can reach 6–7 feet in five years. The new foliage is attractive, with rust-colored hairs.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your kauila; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RHAMNACEAE

(BUCKTHORN FAMILY)

GENUS:

Colubrina

HAWAIIAN NAME:

ʻĀnapanapa (shrub)

SPECIES	STATUS	HAWAIIAN RANGE
C. asiatica	—	ind (HI exc. H, Ka)

HAWAIIAN NAMES:

Kauila, kauwila (tree)

SPECIES	STATUS	HAWAIIAN RANGE
C. oppositifolia	E	end (O, M, H)

Full Sun – Partial Sun

Range
Endemic or Indigenous[1]

Description
shrub or tree

Propagation
seeds and cuttings

1: Range differs for each species.



***Colubrina oppositifolia* flowers – Hawaiʻi — DL**

GENERAL DESCRIPTION

Colubrina is a threatened native tree in dry to mesic forests. It is smaller than *Alphitonia* and both share the same Hawaiian name (another good reason to use their botanical names, which ensures that everyone is referring to the same plant). The yellowish, light-green leaves are 4–6 inches long, opposite, thin, flexible, and egg-shaped, with pinkish veins on the younger foliage. Small, greenish, star-shaped flowers cluster at the leaf axils, and tripartite (three parted) rounded capsules develop, turning brown when mature. The dark red to black hardwood, without dark streaks, also sinks in water and was used by the Hawaiians for spears, kapa beaters, ʻōʻō, and other weapons. The wood is so hard it took the place of metals (Wagner et al. 1990).

The easy to grow *C. asiatica* is more of a sprawling shrub than a tree, with alternate thin glossy leaves 2–3-inches long, occurring naturally in dry coastal sites. Like the *Alphitonia*, drought and drier years produce an increase of seeds with aborted embryos, and the seeds from wetter years have higher viability rates.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Shrub or tree

Mature Height: 5–13 m

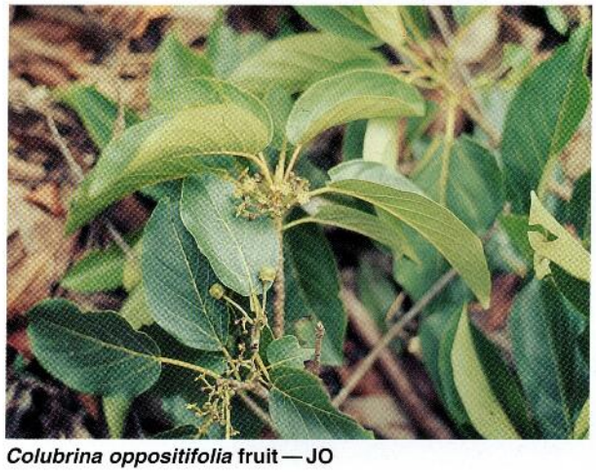
Stem/Trunk: Wood is known for its hardness, beauty, and density

Leaves: Leaves simple; glossy, alternate, margins serrate (*C. asiatica*) or opposite, margins entire, dull (*C. oppositifolia*) depending on the species

Inflorescence/Flower: Flowers are small, perfect, in peduncles; flower parts in fives, five sepals, five petals, five stamens, and the three-celled ovary is partly inferior

Fruit: Fruits are spherical, slightly three-lobed, and the lower half or third enclosed by the nectary disc and floral tube

Seed: Seeds are without an aril, dark brown with a thick and bony seed coat (Wagner et al. 1990)



***Colubrina oppositifolia* fruit — JO**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are mature, brown, and shedding from the tree or shrub.
- Keep the seeds dry in a paper bag until carefully separated. Use a hammer to crack the hard seed coverings open.
- The seeds can be stored in a freezer or in refrigeration for up to ten years, but they will lose some viability. It is best to start with fresh seeds.
- Scarify the seeds with clippers; soak the seeds first if they are too hard to scar.
- Or soak the seeds in hand-hot water or tap water for thirty-six hours. Discard the non-viable floating seeds; if they are hollow when squeezed between your fingers, their embryos are damaged or undeveloped.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1) or 3 parts fine black cinder to 1 part potting mix (3:1).
- Cover seeds with ½ inch of mix, then water them in. Water every other day.
- Keep them in a covered area; never allow them to dry out completely.

GERMINATION (slow-growing trees)

- Germination will occur in ten days to two months for scarified seeds and up to six months for all of the viable soaked seeds.
- Wait until at least four true leaves develop in two months.
- Foliar feed the seedlings with a light solution monthly.
- Using a well-draining mix, transplant them into 2–4-inch pots, depending on the root-ball size.
- Keep them in a shaded area, and repot them into larger pots when they grow twice as tall as their pots, adding new mix every six months to a year.
- Move them into full sun to harden them off and prepare them for outplanting.
- Foliar feed them monthly.

CUTTINGS (*C. asiatica*: easy)

- To propagate clonally, first collect semi-hardwood cuttings as recommended.
- Follow the directions and keep the cuttings moist in a sealed plastic bag.
- Apply rooting powder No. 1 or No. 3, with a fungicide.
- The cuttings should be rooted in two to three months; handle and care for them the same as described for the seedlings.

OUTPLANTING

- See *Alphitonia*, and follow the same protocols.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Colubrina*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

R

RHAMNACEAE

(BUCKTHORN FAMILY)

GENUS:

Gouania

SPECIES	STATUS	HAWAIIAN RANGE
G. hillebrandii	E	end (L, Mo, M, Ka)
G. meyenii	E	end (K, O)
G. vitifolia	E	end (O, M, H)



***Gouania meyenii* flowers and seed capsule – Kaua'i — SP**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
sprawling to erect shrubs

Propagation
seeds

GENERAL DESCRIPTION

These sprawling to erect shrubs occur in the dry to mesic forest; they are either extinct or close to it, with only a few populations remaining in the wild. The papery leaves are alternate and oval-shaped. The small whitish flowers are sometimes fragrant; they develop from the leaf axils, as do the two to three-winged fruit capsules, which contain two to three smooth, narrow, flat, brown seeds. These are slow-growing plants that could stay in a container or be outplanted under or near your *Alphitonia* or *Colubrina* trees. The very existence of the endemic *Gouania* in the wild is dependent on people to go in and control the threats such as alien vegetation, hungry introduced animals, insects, and development. They can also be collected and protected in conservation collections, such as botanical gardens.

Entire Range: Hawaiian endemic

Wild Habitat: Dry to mesic forest

Habit: Erect, climbing to sprawling shrubs

Mature Height: 0.5–20 dm long

Stem/Trunk: Stems of young growth can be densely pale to yellow pilose and then they become glabrate

Leaves: Leaves are alternate, pinnately veined, the margins differing from entire to toothed with each species; leaves can be papery to leathery, upper leaf surface usually smooth,

lower surface with fine hairs, and leaves with leaf stalks

Inflorescence/Flower: Small pale flowers, perfect, flower parts in multiples of five, five sepals, five petals, five stamens, flattened nectary disc, and an inferior ovary

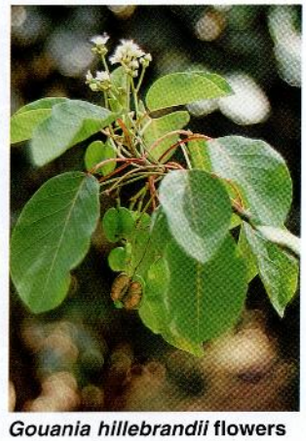
Fruit: Fruit is two- to three-winged, schizocarp

Seed: Black, shiny flat, narrow seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruit capsules when they are brown and shedding from the shrub.
- Keep them dry in a paper bag until they are cleaned.
- Soak the whole fruit in hand-hot water for thirty minutes to one hour.
- Or remove the seeds from the papery three-sided capsules with clippers, exposing the flat, brown shiny seeds inside that need no pretreatment.
- Sow the seeds in a shallow flat onto a mix of 3 parts perlite to 1 part potting mix (3:1) then cover with ¼ inch of mix and water them in.
- Keep the flat in a covered area protected from heavy rains, and water it every other day.
- Once the seedlings start to germinate, foliar feed them monthly with a weak solution to strengthen them.



***Gouania hillebrandii* flowers and seed capsule – NTBG nursery — DR**

GERMINATION (low rates)

- It may take all viable seeds one to six months to sprout.
- Wait until at least four true leaves develop before transplanting.
- Then transplant into 2-inch pots with a well-draining mix.
- Keep them in a covered area and water every other day.
- Repot them into larger pots about every five months or when they grow twice as tall as their pots.
- Move them into full sun to help harden them off and prepare them for outplanting, or keep them in a large pot/container as a display plant.
- Continue to foliar feed them monthly.

OUTPLANTING

- Your plants will be ready for outplanting in one to two years, when they have outgrown a 1–2-gallon pots.
- Choose a site with full to partial sun and well-draining soil; it is best if the soil is amended with coarse cinder.
- Water the plants in, then water weekly when they are dry; monitor them for problems such as poor drainage, insect damage, or drought.
- Plant them among other plants and out of strong winds that may break their thin, brittle branches.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Gouania*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Hibiscus snow scale can infest your plants along the stems and branches; to treat, spray with horticultural oils or systemic pesticides.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly. Water the plants first to reduce any stress.
- The black twig borer bores holes in the thin stems, which kills the branch and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.

R

ROSACEAE
(ROSE FAMILY)

GENUS:
Acaena

HAWAIIAN NAMES:
Liliwai; nani Wai'ale'ale

SPECIES	STATUS	HAWAIIAN RANGE
A. exigua	E	end (K, M)

Partial Sun – Shady

Range
Hawaiian Endemic

Description
clumping perennial herb

Propagation
seeds



Acaena exigua – Maui — SP

GENERAL DESCRIPTION

Acaena is a small, dense, clumping perennial herb. It has leaves that are 1 inch long with six to eight pairs of smaller leaflets. These form a rosette at the top of short stems. *Acaena* is extremely threatened and occurs in high mountain bogs. It had not been seen or collected since 1957 and was feared extinct until 1997, when one plant was discovered in a remote montane bog on Maui. The plant later died in 2000, and the species is now considered extinct in the wild (Wikipedia 2016). The tiny flowers are either perfect (having both male

and female parts) or unisexual (either male or female parts but not both). The flower receptacle is spiny and the fruit is a furrowed achene. Achenes (fruits) develop along the long slender stems which grow far above the foliage. It is best to propagate this endangered herb from seeds.

Entire Range: Endemic to Kaua'i and Maui

Wild Habitat: High montane bogs

Habit: Small, perennial herb

Mature Height: 1–4 cm long

Stem/Trunk: Main stems crowded with leaves

Leaves: Leaves pinnately compound, alternate with stipules attached to the base of the leaf stalks

Inflorescence/Flower: Flowers in short, crowded spikes about 7 mm long, with oblong bracts, and the receptacle (the structure where the flowers are attached) covered with spines about 0.5 mm long. Each flower has four sepals, no petals, two to five stamens, and the stigmas are prominent and feathery.

Fruit: Pale brown achene about 1 mm long, with unnoticeable longitudinal furrows

Seed: Tiny, pale brown seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the achenes; then remove the tiny, pale brown seeds from within them using clippers.
- Soak the seeds in tap water for one hour.
- Surface sow them onto a mix of 2 parts fine black cinder to 1 part peat moss (2:1); water them in.
- Keep them in a cool, shaded, moist area; setting them under an intermittent mist system would be ideal.

GERMINATION

- If the seeds are viable they will sprout in one to three months.
- Wait until four to six leaves develop before transplanting.
- When they are ready, transplant them into 2-inch pots filled with of 2–3 parts fine black cinder to 1 part potting mix (2 or 3:1); water them in.
- Keep the seedlings in a cool, moist, shaded area.
- Repot them into 4-inch pots after about five months.
- Add a small amount of 8-8-8 NPK fertilizer.
- This sensitive plant is somewhat short-lived. It can be left in a container with a shallow tray of water underneath it. Use pure filtered water, free from chlorine or other harsh chemicals.

OUTPLANTING

- Your plants will be ready to outplant in about six months; or when they have outgrown a 4–6-inch pot.
- Choose a cool, shady location, preferably in higher elevations with moist soil.
- These plants need close monitoring and extra care.

PESTS

No known pests recorded.

ROSACEAE

(ROSE FAMILY)

GENUS:

Fragaria

HAWAIIAN NAME:

ʻŌhelo papa

COMMON NAME:

Strawberry

SPECIES	STATUS	HAWAIIAN RANGE
F. chiloensis subs. *sandwicensis*	V	end (H, M)

Shady

Range
Hawaiian Endemic

Description
perennial herb

Propagation
cuttings



***Fragaria chiloensis*—CHL**

GENERAL DESCRIPTION

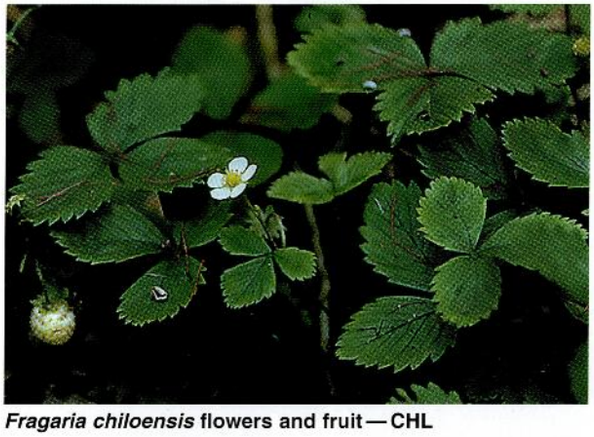
Fragaria (strawberry) are perennial herbs that grow on long underground stolons or runners. They occur in the wild at elevations of 3,500–6,000 feet in dry, disturbed areas, wet forests, and even in subalpine shrublands. They are widely dispersed by birds and they originated from North to South America. The plant is covered with silky hairs, except for the upper surface of the leaves. The leaves, white flowers, and small red fruits develop at the top of long stems (the flower stalks are half of the length of the leaf stalks). The Hawaiian name ʻōhelo means "of berry" and papa "flat spreading." These Hawaiian strawberries are easy enough to grow from newly rooted plantlets. They grow from the nodes along the stolons or runners. Do not collect material unless you have the appropriate growing conditions, specifically cool and dry to wet habitats. They grow best at higher elevations.

Entire Range: Hawaiian endemic

Wild Habitat: Dry disturbed, mesic, subalpine to wet forests

Habit: Rhizomatous and stoloniferous perennial herb with scaly rootstocks, forming colonies

Mature Height: 1–5 cm long
Stem/Trunk: Long, slender stolons
Leaves: Leathery leaves or thin leaves, covered with sparse to dense silky hairs, pinnately compound growing in a basal rosette, with three leaflets, each leaflet with toothed margins
Inflorescence/Flower: Flowers occur in cymes; flower parts are in multiples of five, with five sepals, five petals (white, yellow, or pink), many stamens, in one to three whorls
Fruit: The fruit (red to white) is an aggregate of minute achenes occurring on the enlarged, fleshy receptacle
Seed: Small, dry seeds (Wagner et al. 1990)



***Fragaria chiloensis* flowers and fruit—CHL**

PROPAGATION AND CULTIVATION

CUTTINGS (stolons or runners)

- To clonally propagate your plants first cut off the small, rooted plantlets growing along the runners.
- Reduce some of the lower foliage, leaving three or four new leaves.
- Keep these moist in a sealed plastic bag until they are potted up.
- Pot up the small plantlets in 2–4-inch pots with a well-draining mix of 2 parts black cinder to 1 part potting mix (2:1); water them in.
- Keep them moist in a cool, shaded area; after about a week, begin to foliar feed them monthly.
- Repot them into 6-inch pots when the plant roots are well established in the bottom of the pot; add small amounts of 8-8-8 NPK fertilizer to the mix.
- After a while, your plantlets will be making runners and new plantlets of their own.

OUTPLANTING

- To outplant, first choose a site in a cooler, higher elevation under trees or shrubs; treat it like a ground cover.
- Amend the soil with cinder if it is compacted as this will ensure good drainage; add small amounts of 8-8-8 NPK fertilizer.
- Monitor your plants closely for insects, signs of slugs eating the plants, or wild chickens digging them up.
- Water them when it is dry until they are well established, then water them in times of drought.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Fragaria*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Slugs may eat the leaves and the fruit. If you discover them, apply slug bait or pick them off by hand.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly. Water the plants first to reduce any stress.



***ʻŌhelo papa*—F&KS**

ROSACEAE

(ROSE FAMILY)

GENUS:

Osteomeles

HAWAIIAN NAMES:

'Ūlei; eluehe; u'ulei

SPECIES	STATUS	HAWAIIAN RANGE
O. anthyllidifolia	—	ind (HI exc. Ni, Ka)

Full Sun – Partial Sun

Range
Indigenous

Description
small tree to ground cover

Propagation
seeds and cuttings



***Osteomeles anthyllidifolia* flowers — DR**

GENERAL DESCRIPTION

'Ūlei grows as a small evergreen tree 14 feet in height at higher elevations, to a low sprawling ground cover 1–2 feet height at sea level. The dark-green compound leaves are silvery underneath and covered with tiny hairs. Small, white, five-petaled flowers are slightly fragrant and cluster at the tips of the new growth. The round pulpy fruits are whitish-purple and contain four or five tan, wedge-shaped, stone-hard seeds. The seeds need to be soaked in water to speed up germination. Hawaiians used the long flexible stems to make scoop net handles. They used the flowers and fruits for lei pua, and the tough wood was used to make fishing spears and musical instruments (Abbott 1992). This is an easy plant to grow from seeds and cuttings, and requires little to no maintenance.

Entire Range: Indigenous to the Cook Islands, Tonga, and Hawai'i, on all of the main islands except Ni'ihau and Kaho'olawe

Wild Habitat: Found in a wide variety of habitats including coastal cliffs, dry to mesic forests, and disturbed areas

Habit: Erect to prostrate woody shrub

Mature Height: Up to 3 m in height

Stem/Trunk: Many-branched; the younger branches are grayish and drooping

Leaves: Leaves are leathery, compound with about twenty to twenty-five leaflets, with entire margins, glossy upper leaflet surface, prominent raised veins, some hairs along the midrib, underside of leaflets covered with hairs; brownish stipules

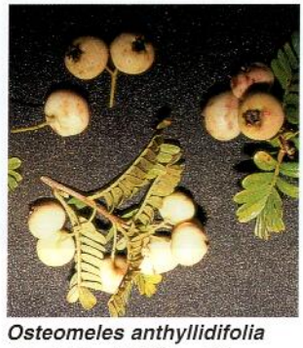
Inflorescence/Flower: Flowers in cymes that occur in terminal inflorescences, flower parts in multiples of five, with five whiter petals, five calyx lobes, fifteen to twenty stamens, and five styles; ovary is inferior

Fruit: The fruit of 'ūlei is a pome, white, fleshy, roundish, and about 1 cm in diameter

Seed: The seeds are yellowish and about 1.5 mm in diameter (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



Osteomeles anthyllidifolia ripe fruit – NTBG — DR

- To propagate by seed, first collect the pulpy fruits when they are soft and whitish in color; keep them moist in a plastic bag.
- Separate the seeds from the pulp as recommended for pulpy seeds.
- Start the seeds fresh for best results, or store them cleaned and dried in refrigeration.
- Soak the seeds in hand-hot or tap water for twenty-four hours.
- After soaking, sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1).
- Cover the seed with ½ inch of mix, and then water them in.
- Keep the flats in a covered, shaded area.

GERMINATION

- Germination of all viable seeds will take one to four months.
- Wait another month until two to four true leaves develop; then they will be ready to transplant into 2-4-inch pots.
- Keep them in partial sun and foliar feed them monthly.
- Repot them after three to five months, or when they have become twice as tall as their pots.
- Move them into full sun to help harden them off and prepare them for outplanting.



Osteomeles anthyllidifolia seedlings – NTBG nursery — KLR

CUTTINGS

- To clonally propagate your 'ūlei, first collect softwood to semi-hardwood cuttings in the spring or early summer when the plant is not in bloom and it is not seeding; follow the protocols for softwood and semi-hardwood cuttings.
- Apply rooting powder Nos. 1–3 at the stem base ends.
- Your cuttings should develop roots in three to five months. Cuttings taken in off-season (fall to winter) will root poorly if they root at all.
- Care for the cuttings the same as directed for the seedlings.

OUTPLANTING

- Your plants will be ready for outplanting in about six months to a year, when they have outgrown a 6-inch or 1-gallon pot.
- Choose a site in the full to partial sun with well-draining soil; amend the soil as directed.
- Water them in, then water weekly and when it is dry until the roots are established.
- Foliar feed them monthly and add small amounts of 8-8-8 NPK fertilizer every three to six months depending on the rainfall. If the soil is healthy, these plants will do well without added fertilizers.

PESTS

- Ants and their associated pests (scales, mealybugs and aphids) can infest your 'ūlei; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

ROSACEAE
(ROSE FAMILY)

GENUS:
Rubus

HAWAIIAN NAMES:
ʻĀkala; ʻākalakala; kala

COMMON NAME:
Hawaiian raspberry

SPECIES	STATUS	HAWAIIAN RANGE
R. hawaiensis	—	end (K, Mo, M, H)
R. macraei	R	end (M, H)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
erect to low-growing shrub

Propagation
seeds and cuttings



***Rubus hawaiensis* flowers — JO**

GENERAL DESCRIPTION

The native raspberries have lost the sharp thorns that their cousins used to deter herbivores (prior to human contact, the Hawaiian Islands hosted no grazing animals). Today, the plants still have prickles, but they have softened. *R. hawaiensis* is a more erect shrub 5–15 feet in height, whereas *R. macraei* is a low-growing shrub trailing along the ground, sometimes rooting at the nodes. Both plants are covered with soft, slender, yellow-to-reddish prickles. The 6-inch-long three-parted leaflets are serrated (toothed along edges), five-petaled dark pink flowers form at the tips of new growth, and dark red sometimes yellow (*hawaiensis*) hairy edible fruits 1–2 inches long are rather tart. A rose-colored dye was made from the fruit juice for kapa cloth (Abbott 1992). In the 1930s, the Hawaiian raspberry was studied for potential commercial use. Some crosses were made with mainland varieties but the fruits were too bitter and tart (Neal 1965). Both of these species are found in the higher elevations mesic, wet forests to subalpine habitats. I germinated seeds at sea-level but the plants did not thrive until they were taken to the mountains where there were cooler temperatures, after which they thrived. When I worked with cuttings at high-elevation nurseries, they easily rooted in two to three months.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic to wet forest and subalpine woodlands or shrublands; steep rocky slopes, open rocky areas, bog margins, or within sheltered thickets of other plants in pastures

Habit: Erect or prostrate shrubs

Mature Height: Stems up to 40 dm long

Stem/Trunk: Shredding bark, sparingly branched, sometimes rooting at the nodes, covered

with slender prickles, stems from sparingly to densely hairy



Rubus hawaiensis fruit — JO

Leaves: Leaves are palmately compound, thin to leathery, with three leaflets, the terminal leaflet the largest; the upper surface covered with a fine coat of hairs, the under surface covered with a soft coat of hairs; leaflet margins toothed; sometimes small prickles can be found on the leaves

Inflorescence/Flower: Flowers perfect, flower parts are in multiples of five, with five petals (dark pink to dusky rose), five calyx lobes, stamens numerous; flowers in inflorescences, with a dense covering a hairs, and some slender prickles

Fruit: Fruit red to dark purple, sometimes yellow, juicy

Seed: Small tan seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are ripe and soft, reddish or yellow; keep them moist in a plastic bag.
- Separate the tiny tan seeds from the fruit as directed for small pulpy fruit.
- Start the seeds fresh for higher germination rates.
- Soak the seeds in hand-hot or tap water for one hour for the best results.
- Surface sow the seeds onto a mix of 3 parts black cinder or 3 parts perlite to 1 part potting mix (3:1); water them in.
- Keep them in a cool, shaded, covered area, which will protect them from drying out or heavy rainfall.

GERMINATION (slow-growing)

- Germination for all viable seeds will take from two to six months.
- Wait until at least four true leaves develop in a few months before transplanting into 2-inch pots.
- Use a mix of 3 parts black cinder to 1 part potting mix (3:1) and add a small amount of 8-8-8 NPK fertilizer to it.
- Keep the seedlings in a cool, shaded area with good ventilation; foliar feed them with a light solution monthly.
- Repot them into larger pots when the plants are twice as tall as the pots.
- Move them into partial to full sun to help harden them off and prepare them for outplanting into higher elevations.

CUTTINGS

- To clonally propagate these raspberries, first collect the leafy softwood cuttings in the early spring from the young sucker shoots just emerging from the soil with a 2-inch section of the root attached; follow the directions for starting softwood cuttings (p.22).
- Apply rooting powder No. 3 with a fungicide.
- Prepare a mix of 3 parts black cinder to 1 part potting mix (3:1).
- It is best if they are kept under an intermittent mist system.
- They should root in about three to five months; handle and care for them the same as directed for the seedlings.

OUTPLANTING

- Your plants will be ready for outplanting in six months to a year, when they have outgrown a 6-inch to 1-gallon pot.
- Choose a site in the higher elevations with cooler temperatures, 1,000 feet and above.
- Plant them near other plants for protection from strong winds.
- Amend the soil with cinder for good drainage and add small amounts of 8-8-8 NPK fertilizer.
- Water them weekly until they are well established or if they are dry, then water only during prolonged periods of drought.

PESTS

- If your plants are stressed from warmer, lower elevations, they will be more susceptible to insect attack from such insects as thrips, slugs, and red spider mites; follow the protocols for controlling them.

RUBIACEAE

(COFFEE FAMILY)

GENUS:
Bobea

HAWAIIAN NAME:
'Ahakea

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
B. brevipes	—	end (K, O) mesic to wet forests
B. elatior	—	end (HI exc. Ni, Ka) mesic to wet forests
B. sandwicensis	V	end (O, Mo, L, M) dry to mesic forests
B. timonioides	V	end (K, O, M, H) dry to mesic forests

Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Bobea timonioides* flowers and fruit – Kaua'i — SP**

GENERAL DESCRIPTION

'Ahakea is restricted to the Hawaiian Islands and is found in the dry to wet forests as small trees that are 20–50 feet in height. The opposite, yellowish, pale-green leaves have red veins and midribs running throughout their length. They cluster at the branch ends, as do the small, inconspicuous, slightly fragrant, greenish, tubular flowers. The flowers have either male or female structures or they may be perfect, meaning they have both sexual parts (polygamodioecious). The small, rounded fruit are purplish-black and contain two thick-walled seeds. The hard, yellowish wood was used by the Hawaiians to frame the hale (house) doorway and to make gunwales on canoes. They used the bark mixed with other ingredients to make a tonic that purified the blood and treated sores (Abbott 1992). *Bobea* are fairly easy to propagate but need well-draining soil in order to stay healthy. If they are outplanted in poor or depleted soil (such as some of Hawai'i's old sugarcane fields) they can develop a fungus (*Rhizoctonia solani*). The symptoms include sudden wilting and blotchy leaves. If the plants are left untreated they will die. To treat this, apply a fungicidal soil drench and carefully follow the directions on the manufacturer's label. As I often say: well-draining soil is the key to healthy native Hawaiian plants.

Entire Range: Hawaiian endemic



***B. elatior* habitat – Maui — F&KS**

Wild Habitat: Dry, mesic to wet forests
Habit: Small trees
Mature Height: 20–50 feet (6–15 m)
Stem/Trunk: Branching; young branches from 1.5–4 mm in diameter near apex
Leaves: Leaves simple, opposite, with translucent reddish midribs and secondary nerves; the leaves have domatia (modified portion of the leaf or stem to provide shelter for certain insects, fungi or algae) scattered in various parts of the leaf; leaves are papery to slightly leathery; stipules in between leaf stalks
Inflorescence/Flower: Flowers perfect or functionally unisexual; flower parts in multiples of four (sometimes five); corolla tubular, flowers small, pale greenish-white, stamens usually hidden within petals, anthers slightly exserted; flowers appear clustered as they are in cymes developing out of the leaf axils
Fruit: The fruit is a small, black to purple drupe
Seed: Seeds have a hard endocarp and lack endosperm (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruit when they are soft and dark-purple; keep them moist in a plastic bag for easy cleaning.
- Separate the pulp from the seeds as recommended for medium pulpy seeds.
- Do not store the seeds; instead, pretreat them by soaking them in tap or hand-hot water for twenty-four hours.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) then cover the seeds with ¼ inch of additional mix; water them in.
- Keep them in a covered area protected from heavy rains; water them every other day.

GERMINATION

- Germination of all viable seeds may take one to six months.
- Wait until at least four true leaves develop (about another month) before transplanting.
- Then transplant them into 2–3-inch pots with a well-draining mix, adding more cinder or perlite; also add a small amount of 8-8-8 NPK fertilizer at this stage.
- Keep the seedlings in a shaded, covered area and foliar feed them monthly.
- Repot them into larger pots in four to six months, when they are twice as tall as their pots.
- Move them into partial sun to harden them off; this will help prepare them for outplanting.

OUTPLANTING

- Your seedlings will be ready to outplant in about one year, when they have outgrown a 1-gallon pot and are healthy.
- Choose a site with partial shade that is also protected from strong winds. Most importantly, the soil must drain well; amend the soil with cinder and add a small amount of fertilizer.
- Water your plants in at first, and then water them weekly and when they are dry.
- Foliar feed them monthly for healthier growth.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Bobea*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly; water the plants first to reduce any stress. Alternating different horticultural oil sprays can improve your results.

RUBIACEAE

(COFFEE FAMILY)

GENUS:

Coprosma

HAWAIIAN NAMES:

Pilo; hupilo

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
C. cymosa	—	end (H) mesic forest
C. elliptica	—	end (K) bogs to wet forest
C. ernodeoides	—	end (M, H) subalpine
C. foliosa	—	end (K, O, Mo, L, M) mesic to wet forest
C. kauensis	—	end (K) mesic to wet forest
C. longifolia	—	end (O) mesic to wet forest
C. menziesii	—	end (H) mesic forest
C. montana	—	end (Mo, M, H) subalpine
C. ochracea	—	end (O, Mo, L, M, H) wet forest and bog
C. pubens	—	end (Mo, L, M, H) wet forest
C. rhynchocarpa	—	end (M, H) mesic wet forest to subalpine
C. ternata	—	end (Mo, M) mesic to wet forest
C. waimeae	—	end (K) mesic forest

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
low sprawling shrub to small tree

Propagation
seeds



Coprosma kauensis **male flowers – Kaua'i — DL**

GENERAL DESCRIPTION

Native pilo grow as low sprawling shrubs to small trees with many branches, and they vary depending on their habitat. They have large to small odorless opposite leaves 1/8 to 2 inches long. Other *Coprosma* species found in New Zealand and elsewhere have foul-smelling leaves. In fact, the name was derived from the Greek *kopros*, meaning "dung," and *osme*, meaning "smell." The small, greenish flowers are either solitary or in small clusters at the leaf axils or at the branch tips. Male and female flowers grow on separate plants (dioecious). The small, rounded fruits (drupes) develop all along the stems and are either orangish-red or jet black, and each contains one seed. The fruits are quite attractive to birds like the Hawaiian goose (nēnē). Hawaiians made a yellow dye from the bark of *C. ernodeoides* (kūkaenēnē) (Abbott 1992).



Hawaiian nēnē goose – *Branta sandvicensis* – Kaua'i — KLR

The black-fruited species *C. ernodeoides* is believed to originate from a separate colonization event from the orange-fruited species. These plants are fairly easy to germinate but some need higher, cooler elevations to do well in cultivation.

Entire Range: Hawaiian endemic to all of the main islands exc. Kaho'olawe and Ni'ihau

Wild Habitat: Mesic, wet to subalpine forests, and bogs

Habit: Low sprawling shrubs to small trees

Mature Height: 1.5–15 m in height, depending on species

Stem/Trunk: Sprawling shrubs to scandent shrubs or trees that root at the nodes to branching trees

Leaves: Leaves simple, opposite, entire margins, with leaf stalks or without, stipules occurring between leaf stalks

Inflorescence/Flower: Dioecious (unisexual), flowers can occur alone, or in cymes out of the leaf axils, flower tubular, bell-shaped or funnel-shaped with petals recurved at the ends; male flowers have anthers that extend well beyond the corolla.

Fruit: Roundish drupe, pulpy-juicy, orange-red or shiny black

Seed: Small, hard seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are mature, orange or black in color and keep them moist in a plastic bag until they are cleaned.



***Coprosma montana* fruit – Hawai'i — DL**

- Separate the small seed from the pulp as recommended for medium pulpy seeds.
- Start the seeds fresh and do not store them; pretreat them by soaking in hand-hot or tap water for twenty-four hours, or you can use no pretreatment at all. They will still germinate within two months to a year.
- Plant them in a mix of 3 parts perlite to 1 part potting mix (3:1) or use fine black cinder; place the seed flats in a mist system for species found in wet forests and bogs, cover the seeds with ¼ inch of additional mix, and water them in.
- Keep the flats in a shaded, covered area.
- Water them every other day.
- Once the seedlings have sprouted, foliar feed them with a light solution monthly.

GERMINATION (slow-growing)

- You can expect all viable seeds to germinate within two months to a year. The seeds do not sprout all at once but instead take turns coming up one or two at a time.
- Wait until at least four true leaves develop, then transplant them into 2–3-inch pots. Use well-draining mix with cinder added.
- Keep the seedlings in a shaded area.
- Repot them into larger pots after about four to six months.
- Move them into partial sun for outplanting or leave them in containers changing the media every six months.

OUTPLANTING

- Your pilo will be ready for outplanting after about one year, when they are growing healthily and have outgrown a 6-inch to 1-gallon pot.
- Choose a site close to their natural habitat such as a bog, wet forest, subalpine or mesic area.
- Amend the soil with cinder to improve drainage, or with decomposed compost to hold more moisture.
- Foliar feed them monthly and add small amounts of 8-8-8 NPK fertilizer every four to six months.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Coprosma*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RUBIACEAE

(COFFEE FAMILY)

GENUS: ***Gardenia***

HAWAIIAN NAMES: **Nānū; nā'ū**

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
G. brighamii	E	end (O, Mo, L, M, H) dry forests; small trees 16ft
G. mannii	E	end (O) mixed mesic to wet forest; trees 15–45 ft
G. remyi	R	end (K, Mo, M, H) mixed mesic to wet forests; trees 30–40 ft

Full Sun – Partial Sun

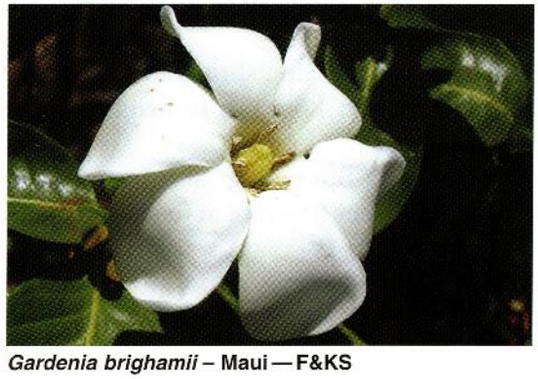
Range
Hawaiian Endemic

Description
trees

Propagation
seeds, air-layering, and cuttings



***Gardenia brighamii* NTBG native section — KLR**



***Gardenia brighamii* – Maui — F&KS**

GENERAL DESCRIPTION

Hawaiian *Gardenias* are most closely related to the Fijian species. *G. mannii* and *G. remyi* are believed to be the result of one colonization to the island. *G. brighamii* is considered as another, because it develops smaller leaves and flowers and occurs in drier habitats. The ovate glossy leaves cluster toward the tips of the branches with fragrant, white, singular flowers, six or nine petals budding on the new growth and blooming later in the day. The large, rounded, greenish-orange fruits contain many flattened, wedge-shaped tan seeds inside the yellowish-pitted pulp. Hawaiians made wooden anvils (kua kuku) from the *Gardenia* wood, dye from the yellowish-orange pulp, and glue from the sticky flower buds (Abbott 1992). *G. brighamii* is the easiest species to grow and maintain in the landscape from seed or air layers. Cuttings will work if the plants are robust and growing healthily. Weak plants will not provide material that can root well on its own. I have grafted the more endangered Moloka'i *G. brighamii* (there is only one plant left in the wild) onto the more common O'ahu *G. brighamii* as rootstock. They took to each other very well, and the graft is a healthy shrub outplanted near the nursery as a mother plant, source material for additional air layers and cuttings.

Entire Range: Hawaiian endemic to all of the main islands exc. Kaho'olawe and Ni'ihau

Wild Habitat: Dry, mesic to wet forests

Habit: Small to taller trees

Mature Height: 6–45 feet (2–14 m) height

Stem/Trunk: Young growth usually covered with sticky, dark exudates secreted by the stipules; branches squarish in cross section, often covered with tiny, fine, sometimes curled surface hairs

Leaves: Leaves opposite, glossy, few, clustered near tips, paper-like to slightly leathery, elliptic, margins entire, stipules conspicuous and forming a membranous collar circling the stem; leaves often have black exudates from stipules on them

Inflorescence/Flower: Flowers solitary, fragrant, white, showy, terminal and axillary; calyx spurs unique and used in conjunction with other characters to key out Hawaiian species

Fruit: Large, hard, round fruits, greenish-orange and filled with yellowish pulp

Seed: Numerous flattened wedge-shaped tan seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruit when it is soft and orangish; keep moist it in a plastic bag until cleaned.
- Separate the medium tan seeds from the pulp by hand or in a strainer with running water.
- The seed can be dried and stored in the refrigerator or in desiccation for up to six years but it will lose some of its viability. It is best to start the seeds when they are fresh.
- Soak the seeds in hand-hot or tap water for one hour. They both germinate within the same time period.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1); cover the seeds with ¼ inch of additional mix and water them in.
- Keep them in a shaded, covered area, and water them every other day.



***Gardenia brighamii* fruits and seeds – NTBG — DR**

GERMINATION

- You can expect germination of all viable seeds within one to eight months.
- Wait about two more months until four to six true leaves develop, then pot the seedlings up into 2-inch pots.
- Use a well-draining mix with cinder in it.



***Gardenia brighamii* seedlings – NTBG nursery — DR**

- Repot them into larger pots in six months or when they have grown twice as tall as their pots. Do not allow the roots to become rootbound in their pots.
- Foliar feed them monthly adding small amounts of 8-8-8 NPK fertilizer to the mix.
- Move them into full or partial sun for outplanting.

CUTTING

- *Gardenia* can be clonally propagated from cuttings when hardwood and semi-hardwood cuttings are used. Follow the protocols described for these types of cuttings and apply rooting powder No. 16.
- The cuttings can be slow to root and you may have to wait about six months to a year; in the wild, these trees are usually stressed and in poor health.
- Care for them and handle them the same as described for the seedlings.

AIR LAYERING

- Follow directions described for air layering, using rooting powder No. 16.
- Your air layers should be rooted in about four months. It is best to air layer in the spring or summer months.
- Your air layers will be ready for outplanting in one to two years, when they have outgrown a 1–2-gallon pot.

OUTPLANTING

- Follow the same outplanting protocols as described for *Bobea* (pg.329).
- If you notice the leaves yellowing, the soil may be depleted of iron; provide supplemental iron or foliar feed your plants with Miracid®.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your Hawaiian *Gardenia*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly; water the plants first to reduce any stress.
- Scales and mealybugs (see above) can be treated with a systemic pesticide, or spray the plant with horticultural oil.

RUBIACEAE

(COFFEE FAMILY)

GENUS:

Gynochthodes (syn: *Morinda*)

HAWAIIAN NAME:

Noni kuahiwi

COMMON NAME:

Hawaiian noni

SPECIES	STATUS	HAWAIIAN RANGE
G. trimera	—	end (K, O, L, M)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***G. trimera* flowers — SP**

GENERAL DESCRIPTION

Endemic noni kuahiwi is a medium-sized tree, occurring scattered in mesic forests. It has much smaller fruits and leaves than the introduced Polynesian species, *Morinda citrifolia* (noni). The papery leaves are glossy on the upper surface and the lower surface is dull. Five to twelve small, greenish-white flowers develop on rounded heads that later become the fruit (syncarp). The syncarp is firm, dark green and woody when mature. It contains many small tan-brown seeds. The viability of the seeds I have received is inconsistent. Some results had fair germination while others had no germination at all. I have described this same pattern with native Hawaiian seeds, where sick plants that are drought-stressed produce poor, non-viable seeds with aborted embryos.

Entire Range: Hawaiian endemic

Wild Habitat: Occurs in gulches, slopes, ridges, and in mesic forests

Habit: Tree

Mature Height: 4–16 m in height

Stem/Trunk: Branches pale brown, sometimes four-angled with many warts and lenticels

Leaves: Leaves are opposite, pinnately veined, papery, oval with pointed ends; about 20 cm long by about 6 cm wide; upper leaf surface is glossy, underside dull and paler. Sometimes the leaf is forms a chamber to shelter insects or fungi (domatia), in noni domatia can occur

near the leaf axils of lateral leaf veins; leaf stalks about 3 cm long, with the stipules fused to them

Inflorescence/Flower: Flowers perfect, about five to twelve flowers in an irregular roundish head, small bracts, four to six short calyx lobes, corolla green, tubular or funnel-shaped

Fruit: Fruit is a drupe that forms a hard syncarp containing cartilaginous, one-seeded pyrenes; The syncarp is green, irregular in shape and about 3.5 cm long and 3 cm in diameter

Seed: Seeds are small, tan, and hard (Wagner et al. 1990)



***G. trimera* seeds — M.Clark USFWS**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruit when it is greenish and shedding from the tree; keep them moist in a plastic bag to help soften the pulp for easier cleaning.
- Separate the seeds from the pulp as directed for small pulpy seeds.
- Do not store the seeds because they will lose their viability.
- Pretreat the seeds by soaking them in tap water for one hour, then sow them onto a mix made up of 3 parts perlite to 1 part potting mix (3:1); cover the seeds with an additional ¼ inch of mix.
- Keep the seed flats in a covered, shaded area and water them every other day.
- Once the seedlings sprout, begin foliar feeding them monthly.

GERMINATION (slow-growing)

- Germination of all viable seeds may take three weeks to six months. Wait about a month until at least four true leaves develop before transplanting.
- Once they are ready, transplant them into 2-inch pots using a well-draining mix made up of 3 parts black cinder to 1 part potting mix (3:1).
- Repot them into larger 4–6-inch pots when the plants are twice as tall as the 2-inch pots.
- Move the plants into partial to full sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- Your noni kuahiwi will be ready to outplant when it has outgrown a 1-gallon pot, or in about one year.
- Choose a site in higher elevations at least 300 feet with partial shade to full sun.
- The soil must drain well; if it does not, amend it with cinder, and add small amounts of 8-8-8 NPK fertilizer.
- Water your noni in, then water when they are dry until they are well established.
- Foliar feed them monthly with Miracid® if the leaves yellow.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your noni kuahiwi; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RUBIACEAE

(COFFEE FAMILY)

GENUS:

Kadua (syn: *Hedyotis*)

HAWAIIAN NAMES:

Au; pilo; kio'ele; manono

COMMON NAME:

Kadua

SPECIES:

There are over twenty-five endemic species of Hawaiian *Kadua*. Many are ranked as threatened and endangered, and they occur on all of the main Hawaiian Islands.

Sun Requirements
Species specific

Range
Hawaiian Endemic

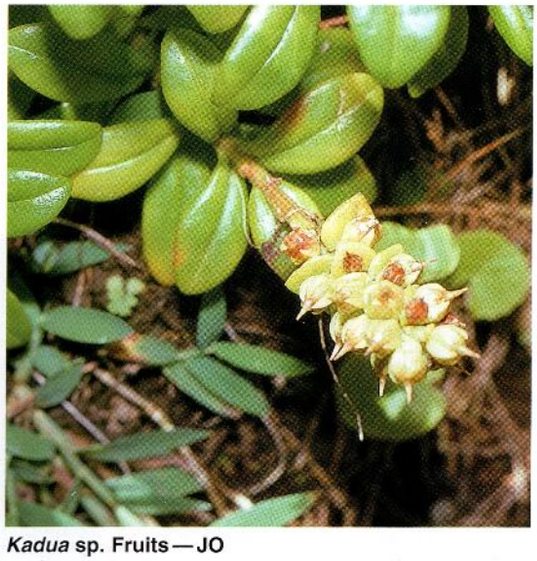
Description
shrub, subshrub, to low-growing herb[1]

Propagation
seeds and cuttings

1: Description differs for each species.



Kadua fluviatilis **flowers – O'ahu — SP**



Kadua **sp. Fruits — JO**

GENERAL DESCRIPTION

Hawaiian endemic *Kadua* come in many growth habits, such as compact or droopy shrubs, sprawling subshrubs to low-growing annual or perennial herbs growing in clumps or mats along the ground; some even have bad smelling ("foetid" or "pilo") foliage when bruised. In the wild, they can occur in mesic to wet forests, on cliff faces, or in rocky outcrops in the cooler alpine zones. The dark green leaves are arranged opposite or in threes, with either inconspicuous green flowers or larger white fragrant ones, which develop on spikes above the foliage or in small clusters along the stems near the leaves. The fruits consist of small woody capsules that open at maturity (dehiscent) and contain many tiny dark-brownish seeds. These plants are easy enough to germinate or root from cuttings but are very susceptible to insect attacks on the new foliage and the roots from aphids, root mealybugs and thrips, which love to live and feed on them. If you observe these pests, spray your plants with horticultural oil or use a systemic pesticide. Keep a consistent pesticide regime because the insects will be back as soon as you let up.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic to wet forests, on cliff faces, in rocky outcrops and in the cooler alpine zones

Habit: Annual or perennial herbs, succulent herbs, shrubs, subshrubs, woody vines, or trees

Mature Height: Variable

Stem/Trunk: Herbaceous to woody, erect to scandent, stems at times prostrate, sometimes four-angled

Leaves: Leaves opposite, with entire margins, stipules between the leaf stalks, papery to leathery; sometimes the leaves smell bad when bruised. Leaf shape variable from lance-shaped to heart-shaped and many shapes in between depending on the species

Inflorescence/Flower: Flowers perfect, however they can sometimes be functionally female; flower parts in multiples of four, flower tubular, trumpet-shaped to bell-shaped; flowers in axillary clusters or inflorescences, white, purple to purplish-green; stamens hidden within the floral tube, ovary inferior or partially inferior

Fruit: Fruit a dry capsule or a fleshy drupe

Seed: Seeds small, dry, numerous with a soft or woody endocarp (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the small dry capsules when they are starting to open; keep them dry in a paper bag until separated.
- Clean the capsules as recommended for small dry seeds.
- The seeds can be stored in desiccation for seven years, or in the refrigerator or freezer. Make sure they are pre-dried and in airtight containers before freezing.
- No pretreatment is needed for the seeds. Surface sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1) and water them in.
- Keep them in a covered, shaded area, protected from heavy rains.
- Once the seedlings start to sprout, foliar feed them monthly.

GERMINATION

- Germination of all viable seeds may take two to five months.
- Once the new seedlings have at least four true leaves, which can take four to six months, they are ready to be transplanted. These are slow-growing seedlings.



***Kadua tryblium* seedlings – NTBG nursery — KLR**

- Pot them up into 2-inch pots and use a well-draining mix made up of 3 parts black cinder to 1 part potting mix (3:1).
- Keep them in a shaded area and begin foliar feeding them monthly.
- After another two to three months repot them into larger pots.
- It is best not to let them flower while they are in pots. Flowering weakens the plant and makes it more prone to insect attack. Wait until they are outplanted to let them flower and seed.
- Move them into partial sun to help harden them off and prepare them for outplanting, or keep as a potted container plant in a cindery mix.

CUTTINGS

- Clonal propagation is best accomplished by collecting softwood green cuttings. Follow the directions for softwood green cuttings (p.22).
- Use rooting powder No. 1, and place the cuttings within a mist system.
- You can expect your cuttings to grow roots in about four to six months.
- Pot them up and handle them the same as the directions for seedlings.

OUTPLANTING

- Your plants will be ready for outplanting in about six months to one year. They will have outgrown a 6-inch or 1-gallon pot and should be growing healthily.
- Choose a site with partial sun and plant them with or under other plants for added protection.
- Amend the area with cinder if the drainage is poor, and add a small amount of 8-8-8 NPK fertilizer to the soil.
- Water them in, and then monitor them weekly, watering when they are dry until they are well established.
- Foliar feed them monthly; if the leaves turn yellow, provide them with applications of Miracid® according to the directions.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your plant; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RUBIACEAE

(COFFEE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Nertera	**Mākole**	*N. granadensis*	—	ind (K, O, Mo, M, H)

Shady

Range
Indigenous

Description
low perennial herb

Propagation
seeds and cuttings



***Nertera granadensis* fruit – Kaua'i — DB**

GENERAL DESCRIPTION

Nertera is a low perennial herb. It is a small trailing plant that roots at the nodes and grows in bogs or as an epiphyte on other plants and likes to have wet feet (roots). The small, thin, pale-green leaves are slightly bad-smelling (foetid) when bruised. The small, greenish-yellow, funnel-shaped, singular flowers, and orange-red, berry-like fruit develop along the stems and at the tips of new growth. The colorful fruits contain small, dark brown shiny seeds that are widely dispersed by birds, which have distributed this genus throughout the tropics.

Entire Range: Indigenous to tropical areas from Colombia, Indonesia, and Hawai'i (K, O, Mo, M, H)

Wild Habitat: In Hawai'i it occurs in wet forests or bogs, wet soil, or on moss mats

Habit: A creeping, perennial herb which roots at the nodes

Mature Height: 2–3 dm long

Stem/Trunk: Prostrate stems which root at the nodes, and numerous lateral branches

Leaves: Leaves simple, opposite, entire margins, with short, flattened leaf stalks, stipules between leaf stalks. Leaves thin and fleshy, roundish and small about 10 mm long by 8 mm wide

Inflorescence/Flower: The flowers are perfect, solitary, with a minute calyx; the corolla is greenish-yellow, funnel-shaped, about 2–2.5 mm long, and has four to five lobes

Fruit: The fruit is a drupe, pulpy, orange-red, round, and about 6 mm long

Seed: Seeds are small, glossy, and dark brown (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEED

- To propagate by seed, first collect the soft orangish fruit and keep it moist in a plastic bag until cleaned.
- Separate the small, brownish seeds from the pulp as directed.
- Start the seeds fresh; do not store them because they will lose their viability.
- Surface sow the seeds onto a dry mix of 3 parts perlite to 1 part potting mix (3:1), then water them in; or sow them onto moist sphagnum moss keeping the moss damp under a mist system.
- Keep the flats in a shaded, covered area protected from drying out and from heavy rains.

GERMINATION

- Germination of all viable seeds may take one to four months.
- When at least two to four true leaves develop, transplant your seedlings into 1–2-inch pots with a mix of 2 parts black cinder and 1 part peat moss (2:1).
- Keep the seedlings in a partially shaded area and foliar feed them monthly.
- Repot them in about three months, using larger pots and new mix.

CUTTINGS

- To clonally propagate your mākole, collect herbaceous cuttings and follow the directions for making herbaceous cuttings.
- Use a mix of fine black cinder or 3 parts perlite to 1 part potting mix (3:1) in shallow flats.
- No rooting powders are needed, keep them moist in a mist system or in a shaded area.
- Your cuttings should develop roots in two to three months. Handle and care for them the same as described for the seedlings.

OUTPLANTING

- Your mākole will be ready for outplanting when it has outgrown a 4–6-inch pot or in about six months.
- It is important to choose a cool, shaded site with good, moist, draining soil; amend it with cinder if needed, or decomposed compost for added moisture.
- Or plant epiphytically on a hāpu'u (tree fern) in the shade while keeping it moist.
- Water your mākole when it is dry and, for healthy growth, begin foliar feeding it monthly with a weak solution.

PESTS

- Slugs may eat the leaves and the fruit; if you discover them, apply slug bait or pick them off by hand.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your mākole; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RUBIACEAE

(COFFEE FAMILY)

GENUS:
Psychotria

HAWAIIAN NAMES:
Kōpiko; ʻōpiko

SPECIES:
Nineteen endemic species of *Psychotria* occur throughout all of the main Hawaiian Islands.

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds



***Psychotria hobdyi* fruits – Kauaʻi — SP**

GENERAL DESCRIPTION

Kōpiko shrubs or trees can grow to 10–40 feet or more in height. They have large, dark-green, shiny, papery, opposite leaves that cluster near the branch ends. The young branches of many species are grayish-brown. Small slender, funnel-shaped white flowers function as either male or female flowers (unisexual) and form in clusters at the branch tips. They mature into orangish, pear-shaped fruits and contain one small tan seed. Once you remove the pulp, there is another thin seed coat to remove. Kōpiko occur in the wild in dry to wet forests but mostly in the mesic forests. It is a fairly slow-growing shrub or tree, preferring a shady, moist environment. The seeds have low germination rates, possibly from the combination of unisexual flowers and small, fragmented populations.

Entire Range: Hawaiian endemic

Wild Habitat: Dry, mesic to wet forests

Habit: Shrubs, small trees, to trees

Mature Height: 3–12 m in height

Stem/Trunk: Branches can be chestnut brown to pale grayish-brown; some species have young branches that are yellowish, to yellow-brown, or reddish

Leaves: Leaves are opposite, membranous to leathery, smooth to covered with fine hairs, stipules with contiguous margins, leaf size and shapes variable depending on the species

Inflorescence/Flower: Flowers are perfect, yet functionally unisexual, occurring in terminal, paniculate inflorescences, calyx four to six lobed, smooth or covered with fine hairs, corolla white, four to six lobed, flowers tubular, nectary at base apex of ovary, anthers exserted beyond floral tube at anthesis (in male flowers); ovary inferior

Fruit: Fruit a drupe, orange, sometimes purplish-black, and roundish to pear-shaped

Seed: Small tan seeds with a thin seed coat (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



Psychotria hobdyi **flowers – Kaua'i — KRW**

- To propagate from seed, first collect the orangish fruit when it is shedding from the plant; keep them moist in a plastic bag until cleaned.
- Separate the pulp and the thin seed coat from the small seeds as directed.
- The seeds can be stored in refrigeration for up to three months; however, you will have higher viability rates from fresh seeds.
- Pretreat the seeds by soaking them in tap water for twenty-four hours (the seeds will sink if they are viable) or scarify them with clippers.
- Use a mix of 3 parts perlite to 1 part potting mix (3:1), cover the seeds with ¼ inch of additional mix and water them in.
- Keep the flat in a shaded, covered area; once the seedlings sprout begin to foliar feed them monthly.

GERMINATION

- All viable seeds will germinate within two to five months.
- Once four true leaves have developed, about one more month, your kōpiko will be ready to transplant.
- Transplant your new seedlings into 2–3-inch pots with a well-draining mix; add cinder for extra drainage.
- Keep them in a shaded, covered area protected from heavy rains.
- At first when they are young, repot them into larger pots with new media every three to five months, and then repot them with new media on a yearly basis.
- If leaves yellow, foliar feed them monthly with Miracid®.
- Move them into partial or full sun to help harden them off and prepare them for outplanting.
- Monitor them for sunburned leaves, indicated by the leaves browning at the edges. If you observe this, move them into deeper shade.

OUTPLANTING

- Your kōpiko will be ready for outplanting in about two years, when they are growing healthily and they have outgrown a 1-gallon pot.
- Choose a site in partial to full sun depending on the species, and be sure the soil is well-drained.
- Plant your kōpiko with other plants in the Rubiaceae family like low-growing *Kadua*, *Nertera*, or *Coprosma* or near other trees such as *Gardenia*, *Bobea*, or *Psydrax*, making sure you give proper room for healthy growth.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your kōpiko; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RUBIACEAE

(COFFEE FAMILY)

GENUS:

Psydrax

(syn: *Canthium*)

HAWAIIAN NAMES:

Alahe'e; 'ōhe'e; walahe'e

SPECIES	STATUS	HAWAIIAN RANGE
P. odoratum	—	ind (HI exc. Ni, Ka)

Full Sun – Partial Sun

Range
Hawaiian Indigenous

Description
shrub to small tree

Propagation
seeds and cuttings



***Psydrax* (*Canthium*) *odoratum* flowers – NTBG — DR**

GENERAL DESCRIPTION

Alahe'e is a small, attractive tree that can reach about 20 feet in height. In the wild, it grows in drier shrublands and forests. The thick glossy, opposite leaves are 2–3 inches long. They glisten in the sunlight and are pointed at both ends. Small, white, fragrant, funnel-shaped flowers cluster at the branch ends as do the small, blackish-green fruit clusters. These small, black, curved seeds are often attacked by a seed borer (on Oahu), which bores a small hole into the embryo to lay its eggs. When they hatch, the larvae feeding on the seed kill it. If you experience this problem, spray the seeds as soon as they develop with an insecticide, then bag them until they ripen. The Hawaiians used the very hard dense wood for 'ō'ō, and sharp-edged adze blades that were used to cut other softer woods, and a black dye was made from the leaves (Wagner et al. 1990). These trees are very easy to germinate and maintain in the landscape. They can be used as a hedge or specimen tree. They make a good native substitute for mock orange (*Murraya* sp.) hedges.

Entire Range: Indigenous to Micronesia, the South Pacific, New Hebrides, New Caledonia, east to the Tuamotus, and in Hawai'i, all of the main islands exc. Ni'ihau

Wild Habitat: Dry shrublands, mesic to wet forests

Habit: Shrub or small tree

Mature Height: 3–6 m height

Stem/Trunk: The wood is durable, hard and was utilized by Hawaiians for tools

Leaves: Leaves are opposite, leathery, glossy on the upper surface, duller on the lower surface, leaves oval to lance-shaped, narrowed at each end. Stipules occur between leaf stalks.

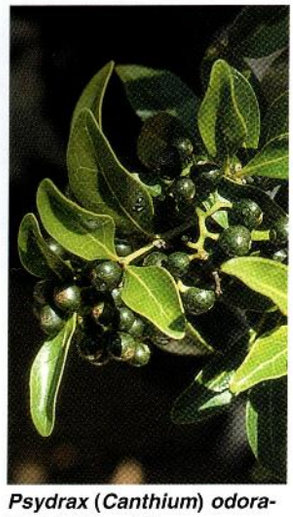
Inflorescence/Flower: Small white flowers are fragrant, perfect or functionally female, occurring in crowned clustered cymes, flower corolla four- to six-lobed, stamens extending beyond petals. Nectary disc fringed with fine hairs

Fruit: The fruit is black, pulpy-juicy, roundish, with a groove on each side, and about 9 mm long

Seed: Seeds are black and incurved (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Psydrax* (*Canthium*) *odoratum* fruits — HB**

- To propagate by seed, first collect the ripe fruits when they are blackish and shedding from tree in the fall; keep them moist and soft in plastic bag until they are cleaned.
- Remove the pulp as recommended for medium pulpy seeds.
- Do not store the seeds; pretreat them with a soak in hand-hot or tap water for twenty-four hours. After the twenty-four-hour period, the viable seeds should sink; throw away any seeds that float.
- Sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), then cover them with an additional ¼ inch of mix and water them in.
- Keep them in a covered, shaded area that is protected from heavy rains.
- Once they sprout, foliar feed them monthly.

GERMINATION

- You can expect all viable seeds to germinate in about one to four months; wait until at least four true leaves develop before transplanting.
- When they are ready to transplant, put them into tall 2-4-inch pots giving the roots ample room to grow down. Do not allow these trees to become root-bound in their pots.
- Use a well-draining mix with small amounts of 8-8-8 NPK fertilizer.
- Keep them in a shaded area, and repot the seedlings into larger pots about every four months.
- Move them into full sun to help harden them off and prepare them for outplanting.
- Foliar feed them monthly with Miracid® if the leaves yellow.

OUTPLANTING

- Your alahe'e will be ready to outplant in about ten months to a year, when they have outgrown a 1–2-gallon pot.
- Choose a site protected from strong winds that is in full to partial sun.
- Amend the planting hole to create good drainage and add small amounts of 8-8-8 NPK fertilizer.
- Water your plants in, and then water them monthly until they are established.
- These trees need little to no care if they are planted in the right environment. Sometimes the foliage may yellow; if it does, foliar feed them with Miracid®, or soil drench them with chelated iron to add extra iron to the surrounding soil.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Psydrax*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- The seeds are sometimes attacked by native seed weevils that bore into the embryo and feeds, rendering the seeds nonviable. Use a systemic pesticide amended into the soil around the tree or bag the fruit when young until they ripen to prevent this.

RUTACEAE

(RUE OR CITRUS FAMILY)

GENUS:

Melicope

HAWAIIAN NAMES:

Alani; alani kuahiwi; mokihana

SPECIES:

Forty-nine endemic species of Melicope occur on all of the main Hawaiian Islands and two species are found in the Marquesas.

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
trees or shrubs

Propagation
seeds



Melicope clusiifolia **habitat fruit – Maui — F&KS**

GENERAL DESCRIPTION

Melicope are among the largest flowering plant genera in Hawai'i. They occur primarily in mesic to wet forests, and some species even grow in or near bogs (such as *M. cruciata*, *M. feddei*, *M. kavaiensis*, *M. paniculata*, and *M. waialealae*). They develop as small shrubs with small leaves or as large trees with large leaves. They even grow as prostrate and sprawling plants along the ground. The thin, papery, dark-green leaves are opposite along thin stems. Some species have a pleasant anise odor to them (*M. anisata*). The dry, shiny black seeds were probably eaten by birds and arrived to the Hawaiian Archipelago internally. Even though the seeds are not pulpy or fleshy, birds still find them attractive. These are easy to grow from the black mature seeds. The plants need a cool, moist, shady environment with well-draining soil to thrive.

The pleasant-smelling mokihana (*M. anisata*) fruits are used in making leis and to scent kapa cloth. Kaua'i is the only island this species occurs on. These leis are so cherished that some people strip trees in the wild to get every fruit. This damages them and reduces future generations. I have even heard that trees have been cut down to get to the fruits. They are loved to death. We must show more respect for the native Hawaiian plants; when they are gone from the wild, they will be gone forever.

I have grown healthy mokihana at 15 feet elevation above sea level in the NTBG nursery. Some were outplanted at 100–300 feet elevation where they are growing slowly but steadily. I suspect that these plants can be grown along with maile in Hawai'i's backyards for lei making. This can reduce collecting pressure on the wild populations.

I noticed one day that the pesky introduced fruit flies were all over the leaves of the mokihana in the NTBG nursery, but were not injuring the plants. I discovered that they were taking up the anise scent to use as a pheromone, a way for them to attract insects of the opposite sex. So I started to use the leaves in homemade flytraps. At first I was trapping about 100 fruit flies a day. Then it tapered off to about twenty a day. This demonstrates an effective and natural pest control.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic to wet forests, and in or near bogs

Habit: Trees or shrubs

Mature Height: Variable depending on the species

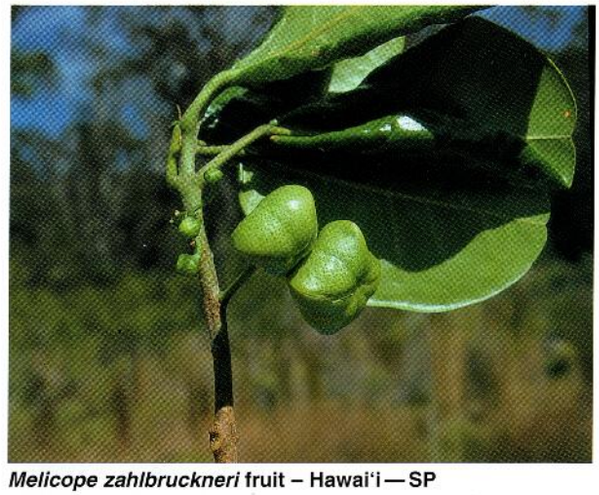
Stem/Trunk: Stems (at least new growth) have a covering of fine, simple hairs; stems are rarely without hairs or glands. Sometimes waxy scales are present; young branchlets are often compressed or quadrangular (square in cross-section).

Leaves: Leaves are simple, opposite or whorled, papery to leathery, depending on the species. Leaves have pinnate venation, entire margins, and leaf stalks.

Inflorescence/Flower: Flowers are small, functionally unisexual and each plant has a mix of perfect and unisexual flowers on it. Flowers occur in cymes or paniculate inflorescences. Each flower has small, opposite bracts; four sepals, four petals; the petals are green, white, pale yellow or pinkish; the stamens in functional male flowers are about the same length as the petals, or they may extend beyond the petals. The ovary is inferior.

Fruit: Fruit is four-valved, or lobed, sometimes cuboidal capsule, the carpels dehiscing at maturity

Seed: Seeds are shiny black (Wagner et al. 1990)



***Melicope zahlbruckneri* fruit – Hawai'i — SP**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the green-brown dry capsules when they are starting to split open, and keep them dry in a paper bag.
- Remove the shiny black seeds from the capsules by hand.
- The seeds can be stored for up to two years in desiccation, refrigerator, or at room temperature.
- To pretreat the seeds, first soak them in tap water for three to five days to penetrate into the hard seed coat, changing the water a few times. If the seeds sink, they are viable.
- Scarified seeds did not germinate well; the embryos rotted.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), then cover with ¼ inch of additional mix. Water the seeds in.
- Keep them in a shaded area.
- Foliar feed them once the seedlings sprout with a light solution.

GERMINATION

- Germination of all viable seeds may take one to eight months. The seeds take turns sprouting, so be patient, because it is well worth the wait.
- Wait another one to two months for at least four true leaves to develop before transplanting them into 2–3-inch pots.
- Use cindery soil that is well-draining with small amounts of 8-8-8 NPK fertilizer mixed in.



Mokihana one-and-a-half-year-old seedlings – NTBG nursery — KLR

- Keep the seedlings in a shaded area and water them every other day or when it is dry.
- Foliar feed them monthly.
- Repot them into 4–6-inch pots in five to six months when they have outgrown their pots.

OUTPLANTING

- Your alani will be ready to outplant in one to two years, when they have outgrown a 1–2-gallon pot.
- Choose a cool, moist shady site out of strong drying winds with well-draining soil; amend with cinder if necessary and/or a well decomposed compost for added moisture, and mix in a small amount of 8-8-8 NPK fertilizer.
- Water your plants in, then water them when it is dry until they are well established.
- Monitor your plants closely at first for poor growth and leaf yellowing; check to see if the soil is not draining well.

PESTS

- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your plants; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Fruit flies may be discovered on the leaves. Do not worry, they are not harming the plants.

RUTACEAE
(RUE OR CITRUS FAMILY)

R

GENUS:
Platydesma

HAWAIIAN NAME:
Pilo kea lau li'i

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. cornuta	R	end (O) mesic forests
P. cornuta var. *decurrens*		end (O) mesic forests
P. remyi	V	end (H) wet forests
P. rostrata	R	end (K) mesic forests
P. spathulata	—	end (K, O, M, H) mesic to wet forests

Shady

Range
Hawaiian Endemic

Description
shrub to tree

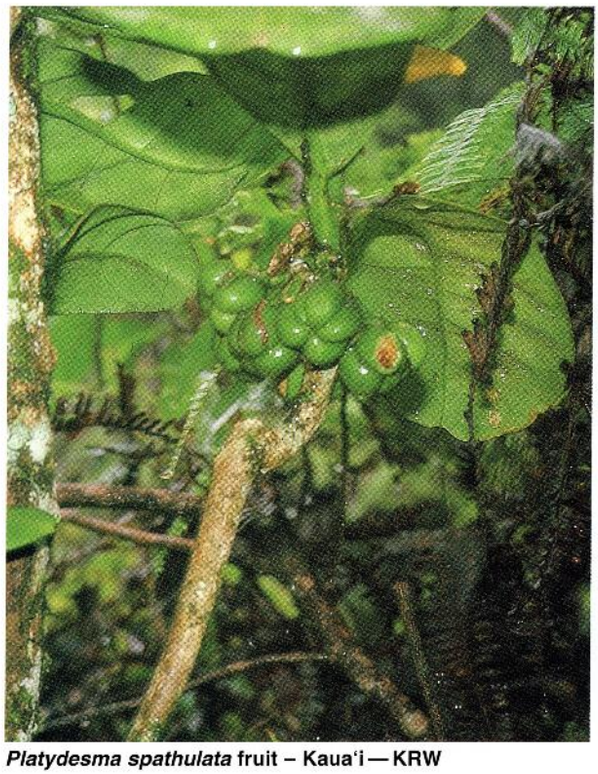
Propagation
seeds



***Platydesma cornuta* flowers – O'ahu — KRW**

GENERAL DESCRIPTION

Hawaiian *Platydesma* are believed to result from a separate colonization occurrence from other Hawaiian Rutaceae. They are short shrubby trees, 10–20 feet tall, with shiny, narrow, opposite, leathery leaves 7–15 inches long. Large, four-petaled, creamy-white flowers 1 inch long develop along the older, shorter stems below the foliage. The four- to five-parted fruits are dry and contain two black, glossy seeds per cell. *Platydesma* need about the same care as *Melicope*. Their seeds are slower to germinate and can take up to a year to germinate even when they are scarified or soaked.



***Platydesma spathulata* fruit – Kaua'i — KRW**

Entire Range: Hawaiian endemic
Wild Habitat: Wet to mesic forests, diverse mesic forests, and valleys
Habit: Shrubs to shrubby trees
Mature Height: 1–12 m height
Stem/Trunk: Palmoid or sparsely branching, branches spreading and leafy toward apex; wood brittle
Leaves: Leaves are simple, opposite, leathery and either soft to firm, varying in shape according to species; midribs are marked with longitudinal grooves on the upper surface. Leaf stalks very short (about 0–6 mm long), or longer (10–95 mm long)
Inflorescence/Flower: Flowers are perfect, flower parts are in multiples of four, a few flowers occur in axillary, cymose inflorescences that are shorter than the leaves, the four white-cream petals enclose eight stamens; there are four carpels
Fruit: Fruits are developed from four-lobed carpels, and have varying degrees of "beak" formed on them
Seed: Seeds are glossy black, bony, and angular (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect and clean the seeds as described for *Melicope* (p. 344).
- Scarify the seeds with clippers and be careful not to damage the embryos. Do not soak the seeds after scarification.
- Or soak the seeds in tap or hand-hot water for forty-eight hours. The viable seeds will sink; discard the nonviable floating seeds.
- Sow seeds and care for seedlings as described for *Melicope*.

GERMINATION (slow-growing)

- Like many native plants, not all of the seeds are going to germinate at once. They take turns, so you need to be patient.
- Wait until at least four true leaves develop before transplanting.
- When they are ready, transplant them into 2–3-inch pots.
- Use a well-draining soil mix made of 3 parts black cinder to 1 part peat moss or 1 part potting mix (3:1).
- Foliar feed them monthly.
- Water them every other day when it is dry.
- Keep them in partial shade.
- Repot them when they are twice as tall as their pots.

OUTPLANTING

- Outplanting *Platydesma* is the same as alani (p. 346). They need a cool shady, moist environment with well-draining soil.

PESTS

- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your plants; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

RUTACEAE

(RUE OR CITRUS FAMILY)

GENUS:

Zanthoxylum

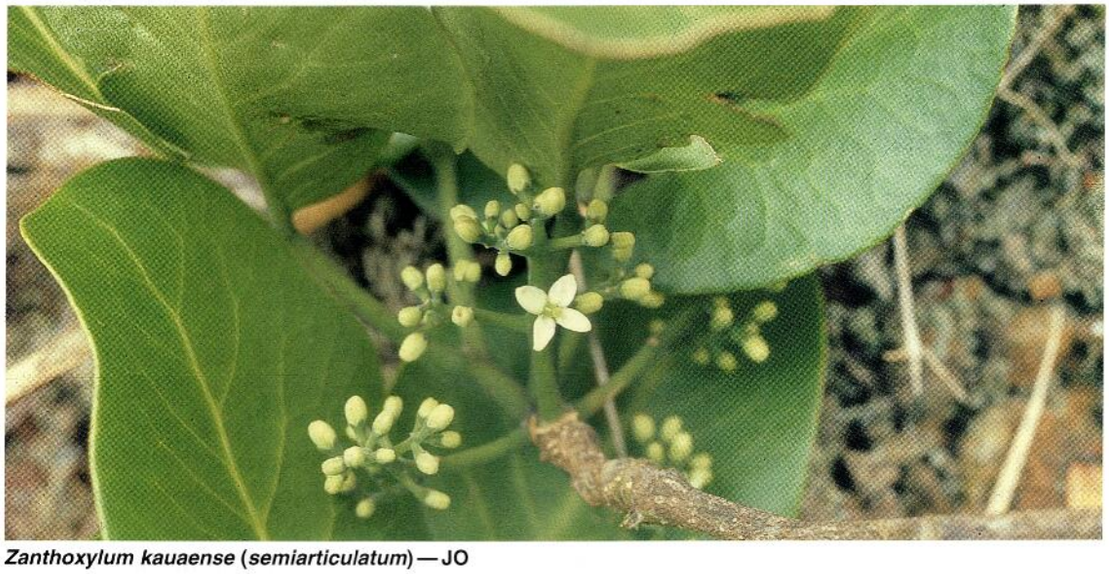
HAWAIIAN NAMES:

A'e; mānele; hea'e

COMMON NAME:

Fagara

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
Z. dipetalum var. *dipetalum*	R	end (K, O, Mo, H) dry to mesic forests (Kāwa'u)
Z. dipetalum var. *tomentosum*	R	end (H) dry forest
Z. hawaiiense	E	end (HI exc. O, Ni, Ka) dry to mesic forests
Z. kauaense	—	end (HI exc. Ni, Ka) dry to wet
Z. oahuense	R	end (O) mesic to wet forests



Zanthoxylum kauaense (semiarticulatum)—JO

GENERAL DESCRIPTION

A'e are small trees 10–40 feet tall, occurring in dry to mesic forests; they are rarer in wet forests. They are easily recognized by the pinnate leaves with (usually) three leaflets. The flowers are small, greenish-white, sometimes tinged with red. They develop in small branching spikes on the new growth just below the foliage. Later, small, green, dry fruits called follicles develop. They are one- or two-parted and dehiscent, opening when they mature. The follicles contain one small black shiny seed per pod. I have found that often the seeds are aborted and have no embryo, or they have low germination rates and the seedlings are weak. This may be the result of several factors. For example, the trees may have been stressed from drought. Or it may be the fact that they have unisexual flowers (either male or female flowers on separate plants). It may be that they need to be grown in higher, cooler elevations (the NTBG nursery was only at 15 feet above sea level).



Zanthoxylum dipetalum—JO

Entire Range: Hawaiian endemic

Wild Habitat: Dry, mesic to wet forests

Habit: Small trees

Mature Height: 1–15 m height

Stem/Trunk: Young branches are subtended by a pair of bud scales; unarmed, bark can be finely fissured, grayish to dark brown

R

Partial Sun

Range
Hawaiian Endemic

Description
trees

Propagation
seeds

Leaves: Leaves are pinnately compound, leaflets have entire margins, and the terminal leaflet stalk is often jointed

Inflorescence/Flower: Flowers are unisexual and the plants either male or female; flowers are white, yellowish-white to reddish, and in multiples of two (or four), including the stamens, with one carpel; the flowers occur in cymose inflorescences

Fruit: Small, dry green fruits, one to two follicles, with either a rounded or beaked apex

Seed: Shiny black seeds, one per fruit, 7–18 mm long (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect and clean the seeds the same as described for *Melicope*.
- The seeds can be stored for up to two years in desiccation, refrigeration, or at room temperature.
- To pretreat the seeds, soak them in hand-hot or tap water for twenty-four to forty-eight hours.
- Sow them onto a mix made of 3 parts perlite to 1 part potting mix (3:1)
- Water the seeds in, then water every other day.
- Keep them in a covered, shaded area.



***Zanthoxylum kauaense* seeds — KM**

GERMINATION

- Germination of all viable seeds may take one to eight months.
- Foliar feed the seedlings once they have sprouted.
- Transplant them into 2–4-inch pots when at least four true leaves have developed.
- Use a mix made of 3 parts black cinder to 1 part potting mix (3:1) and add small amounts of 8-8-8 NPK fertilizer.
- Keep them in partial shade to help protect them from drying winds or heavy rainfall.
- Repot them into larger pots and add new media every six months or when they have grown twice as tall as their pots.

OUTPLANTING

- Your plants will be ready for outplanting in one to two years, when they are healthy and have outgrown a 1–2-gallon pot.
- Choose a site protected from strong wind, in partial shade, and with well-draining soil; amend the soil with cinder if necessary and mix in a small amount of 8-8-8 NPK fertilizer to the soil.
- Continue to foliar feed them every three months, adding more 8-8-8 NPK fertilizer every six months.
- Monitor them closely to see if the soil is draining well and if they are producing new leaf growth.
- Water them when it is dry until they are well established.

PESTS

- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your plants; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

SANTALACEAE

(SANDALWOOD FAMILY)

S

GENUS:

Exocarpos

HAWAIIAN NAME:

Heau; au; hulumoa; kaumahana

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
E. gaudichaudii	R	end (HI exc. K) dry ohi'a forests and alpine areas
E. luteolus	E	end (K) borders of bogs
E. menziesii	—	end (L, H) lava flows and 'ōhi'a shrubland



***Exocarpos gaudichaudii* – Moloka'i — SP**

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds

GENERAL DESCRIPTION

Native heau occur as small, shrubby trees and are found on exposed ridges, in drier habitats. They are easily recognized by the peculiar broom-like appearance of the densely branched, pale-green leaves. These resemble stiff, leafless twigs though bearing a few broad flattened leaves. The flowers are greenish-yellow to reddish and fleshy. There are usually perfect flowers with both male and female parts on the same plant. The one-seeded drupes are enclosed in a pulpy, cup-like structure that is either yellow or reddish when mature. I have noticed that these small hard seeds have low germination rates, if they germinate at all. In drier years the seeds seem to not be viable. I have only received small lots of seeds, too few to conduct proper tests to determine the best pretreatments and discover the germination rates. When collecting seeds, try to avoid letting the pulp dry on the drupe seeds because this causes them to become dormant and increases the germination time. Instead, keep the drupes moist in a plastic bag until they can be cleaned, and then clean them before they mold. These plants prefer dry habitats, in cooler, higher altitudes.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic forests, open shrublands, bog borders, dry ridges, and lava flows

Habit: Small trees to shrubs

Mature Height: 0.5–5 m height

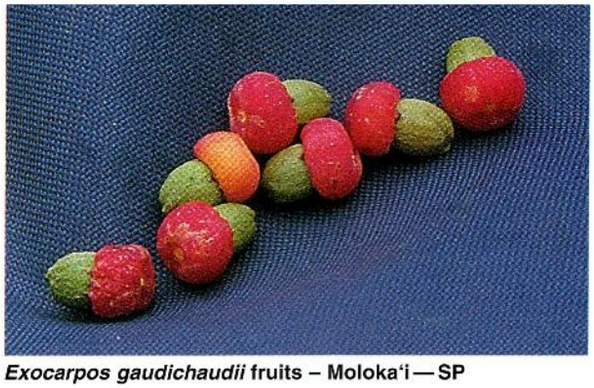
Stem/Trunk: Stems green, stiff, densely branched toward the tips giving them a "broom-like" appearance

Leaves: Leaves alternate and in two forms, one form is minute scales, the other is large, expanded, elliptic foliar leaves, and there are no leaf stalks

Inflorescence/Flower: Flowers are small (0.5–3 mm long), perfect; they have no flower stalks; they are in multiples of five; they grow at the tips of the branches and from the axils in spikes; the flowers are green, yellowish-green, to red

Fruit: Fruit is a yellow to brilliant red one-seeded drupe; the fruit is embedded in a receptacle (entire fruit about 7–16 mm long)

Seed: Small hard seeds (Wagner et al. 1990)



***Exocarpos gaudichaudii* fruits – Moloka'i — SP**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the drupes when the pulp is soft, and yellowish or red, depending on the species.
- Keep them moist until they can be cleaned.
- Start the seeds fresh because they do not store well.
- To pretreat them, soak them in tap or hand-hot water for twenty-four hours.
- Sow the seeds onto a mix made up of 3 parts perlite or 3 parts fine black cinder to 1 part potting mix (3:1), and water them in.
- Keep them in a covered area, watering them every two days, but do not allow them to dry out completely.
- Once the seedlings sprout, foliar feed them monthly with a light fertilizer solution.

GERMINATION (slow and low rates)

- Germination of all viable seeds can occur in about one month to a full year, and they sprout sporadically.
- Wait until at least four to six true leaves develop before transplanting them.
- Transplant them into a 2-inch pot.
- Use a mix of 2 parts black cinder and 1 part potting mix (2:1), and add in a small amount of 8-8-8 NPK fertilizer to the mix.
- Keep them in an area protected from heavy rains; if the foliage yellows, foliar feed them with Miracid® or soil drench them with a liquid iron-chelated fertilizer.
- Repot them into larger pots in three to six months, when they are twice as tall as their pots or yearly when they are older.
- Move the plants into full to partial sun to harden them off and help prepare them for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in about one year, when they are growing strong and healthily and have outgrown a 1-gallon pot.
- Choose a site that is in higher elevations within a cool dry habitat. Another option is to leave them in a cement container with a cindery well-draining soil and place them in an area where you can control the amount of moisture the plant receives.

PESTS

- Your heau can be susceptible to sucking insects such as scales, aphids, mealybugs, thrips, and mites. To treat them, spray your plants with horticultural oil.

SANTALACEAE

(SANDALWOOD FAMILY)

S

GENUS:
Santalum

HAWAIIAN NAMES:
'Iliahi; 'Iliahialo'e

COMMON NAME:
Hawaiian sandalwood

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
S. ellipticum	—	end (HI) coastal sandalwood
S. freycinetianum		end (O, M) dry to wet forests
S. haleakalae var. *haleakalae*		end (M) dry alpine shrubland
S. haleakalae var. *lanaiense*	—	end (Mo, L, M) dry to wet forests on slopes or ridg
S. involutum		end (K)
S. paniculatum var. *paniculatum*	—	end (H)
S. paniculatum var. *pilgeri*	—	end (H) dry to wet forest
S. pyrularium		end (K)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds



***Santalum ellipticum* flowers – O'ahu — HB**



***Santalum lanaiensis* flowers – Lana'i — SP**

GENERAL DESCRIPTION

Sandalwood trees are partially dependent on other plants; their roots attach to a neighboring, host plant's roots (hemi-parasitic), extracting nourishment (nitrogen) from them. They grow into shrubs or small trees, 7–25 feet tall, with thick leathery evergreen leaves that are arranged opposite along the stems. Small, slightly fragrant, four-parted, greenish or red flowers cluster on pedicels at the leaf axils or at the branch ends. These later ripen into blackish-purple pulpy drupes containing one seed with a hard stony seed coat. The sandalwood trade was the first profitable export industry in Hawai'i, from about 1810–1840. In the end, all of the groves of sandalwood were cut down, with profits totaling about four million dollars. Hawaiian chiefs still went into debt buying ships and other extravagant goods with the money and forced their people to labor in the forests, cutting and transporting the lumber to harbors (Neal 1965). This part of the history of Hawai'i was a sad time. The Hawaiians labored so hard for so little and the trees did not benefit, either.

The drupe seeds and the hemi-parasitic tendencies of the root are the tricky components to the germination and maintenance of healthy sandalwood trees. I have set up tests with different seed pretreatments and tried various host plants in the pots with the sandalwood seedlings. Soaking the seeds in hand-hot water for twenty-four hours worked best. If the seeds did not

sprout after six months I would remove them from the mix and resoak them, and then they germinated within a month. The sandalwood trees did not thrive when planted with host plants in their pots. Sandalwood trees do best when outplanted with any plant in the Fabaceae family. Actually, any common native plant that is fast-growing and is nitrogen-fixing (roots produce nitrogen) will work. Collect the seeds from healthy strong trees that are not drought stressed and the seeds are more likely to be viable and will germinate more quickly.

Entire Range: Hawaiian endemic

Wild Habitat: Ridges, slopes, gulches, dry shrublands and forests, mesic to wet forests, fog swept areas, subalpine regions, lava or cinder cones

Habit: Sprawling shrubs, shrubs to small trees; hemi-parasitic on the roots of other plants



***Santalum pyrularium* fruit — DR**

Mature Height: 1–13 m height

Stem/Trunk: Sometimes the branches are drooping, depending on the species

Leaves: Evergreen leaves, simple, opposite, with entire margins and short leaf stalks; texture and shape are variable depending on the species

Inflorescence/Flower: Flowers perfect, in compound cymes, flower shape and colors variable and include greenish, yellowish-brown, orange, red, dark-red, yellow, cream, or salmon; corolla bell-shaped to cylindrical

Fruit: Fruits are one-seeded drupes, dark purplish-black and pulpy

Seed: Medium seeds with a hard endocarp (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the drupes when the pulp is mature and blackish-purple. Do not allow the pulp to dry on the seed, as this causes a state of dormancy and makes germination more prolonged. Keep them moist in a plastic bag until they can be cleaned.
- Separate the seeds from the pulp as directed for medium pulpy seeds.
- Start the seeds fresh to get the highest germination rates, or they can be stored dry in the refrigerator
- Soak the seeds in hand-hot or tap water for twenty-four hours. The viable seeds will sink.
- If you have problems with fungal diseases, put a fungicide in the water for the last ten minutes of soaking; follow the directions on the manufacturer's label.
- Sow the seeds onto a mix of 3 parts perlite or 3 parts fine black cinder to 1 part potting mix (3:1), and then water them in.
- Keep the seed flats in a shaded, covered area protected from heavy rains.

GERMINATION (slow-growing sandalwood)

- Germination is very sporadic; it will take from two months to a year for all viable seeds to sprout.
- After several months to a year if there is no germination, I re-soak the seeds to test their

viability. Discard floating seeds and re-soak the sinking seeds for another twenty-four hours, after soaking scarify the seeds. Re-sow them in the same mix, should germinate in another month or so.

- Once the seedlings germinate, foliar feed them monthly. If the leaves yellow, soil drench the plants with chelated iron or Miracid®, follow direction on label.
- Wait another two to three months, when at least four true leaves develop, before transplanting them into 4-inch pots.
- Use a well-draining mix of 3 parts black cinder to 1 part potting mix (3:1), adding a small amount of 8-8-8 NPK fertilizer to the mix.
- Keep your seedlings in a shaded area and foliar feed them monthly.
- Repot the sandalwoods in about five to six months, when they are twice as tall as their pots.
- When they are older, they can be repotted once a year into larger pots or containers using new media.



***Santalum paniculatum* seedlings – NTBG nursery — DR**

OUTPLANTING

- Your sandalwood will be ready to outplant in one to two years, when it is growing strongly and has outgrown a 1–2-gallon pot.
- The plants require more care than others, but are well worth the extra effort.
- It is important to plant out your sandalwood with a host plant. I have *S. ellipticum* planted next to an *Acacia koa* tree and both plants are growing fantastically. I prefer to use Hawaiian native species as host plants instead of the introduced species.
- Choose a site with full to partial sun and well-draining soil. Amend the soil with cinder or compost if needed for proper drainage for added moisture.
- Water them in, and then monitor them weekly. Water them when they are dry until they are well established.
- If the foliage yellows, soil drench your plants with a light solution of chelated iron or foliar feed them with Miracid®.

PESTS

- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your sandalwood; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Whiteflies can infest the underside of the leaves; if they do, wash them off with a strong spray of water or treat them with horticultural oil and/or systemic pesticides.

S

SAPINDACEAE

(SOAPBERRY FAMILY)

GENUS:
Alectryon

HAWAIIAN NAME:
Māhoe; 'ala'alahua

SPECIES	STATUS	HAWAIIAN RANGE
A. macrococcus		
var. *auwahiensise*	E	end (M)
var. *macrococcus*	E	end (K, O, Mo, M) mixed mesic forests

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
tree

Propagation
seeds



***Alectryon macrococcus* fruit — JO**

GENERAL DESCRIPTION

Māhoe are small-to-medium-sized trees 10–35 feet tall, with large compound leaves and two to six leaflets; the lower surfaces of the young leaflets are covered with a rust-colored tomentum (small woolly hairs). They occur rarely in dry to mesic forests because rats, seed borers, and historically humans have eaten the fleshy red aril (fleshy thickening of the seed coat) and the mild-flavored seeds. Very small flowers without petals develop along short branching spikes. These later develop into large rounded brown fruits. Māhoe once had smaller fruits when it first arrived to the Hawaiian Islands; it now has large fruits, which is an adaptation to living on an island. This reduces or even stops seed dispersal (Carlquist 1980, Grant 1998). Māhoe in Hawaiian means twins referring to the fruits that sometimes develop with two large seeds. The trick to germinating these seeds is that you have to take off the thin, hard outer coat, and then the second reddish fleshy inner coat, revealing the dark brown seed, ¾ inch in diameter, which has a small, V-shaped flap or tail on one side. This is where the root emerges and can be easily damaged when removing the outer seed coat. Work slowly and carefully.

Entire Range: Hawaiian endemic
Wild Habitat: Dry to mesic forests
Habit: Tree

Mature Height: 3–11 m height

Stem/Trunk: Pubescent with simple hairs, branches reddish-brown, covered with fine, parallel line marks, the younger branches covered with yellowish-brown fine hairs

Leaves: Leaves are compound, leathery to papery; leaflets in two to five pairs, are oval and a little asymmetrical, about 20 cm long by 8 cm wide; upper leaflet surfaces are glossy and smooth, undersides show venation pattern and are covered with a fine layer of dense brown hairs when young that thin with age

Inflorescence/Flower: Flowers are small, about 1–3 mm long, perfect or just male; they grow in panicles up to 30 cm long; flowers lack petals, stamens are six to eight in perfect flowers and nine to thirteen in male flowers; flowers have a dense covering of hairs

Fruit: Fruit is hard, roundish but irregularly in shape; up to 7 cm in diameter, a rough outer skin

Seed: Dark brown seed with a hard seed coat, round and about 2 cm in diameter, one side has a fleshy, smooth, scarlet-red aril, the other is compressed and glossy (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the large brown fruits when they are shedding from the tree; keep them dry in a paper bag until they can be cleaned.
- Carefully remove the first two seed coats by hand, using a small knife.
- Do not store the seeds, as they will lose viability. Start them fresh to achieve optimum germination results.
- Place the cleaned seeds (after removing the two coats) onto moistened sphagnum moss under a mist system (do not use stream or pond water, which could be contaminated with diseases or chemicals which would rot the seeds).
- Or place seeds onto a mix of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1) under an intermittent mist system.
- An alternative is to keep them in a covered, shaded area and water them every other day.

GERMINATION

- Germination of all viable seeds takes about one to six months; it can take much longer if the seed coats are not removed. Be patient.
- Once they have germinated, transplant them into 3-4-inch pots with a mix of 3 parts black cinder to 1 part potting mix (3:1) and mix in a small amount of 8-8-8 NPK fertilizer.
- Water them in, then water every other day.
- Foliar feed them monthly.
- These are fast-growing seedlings. They require repotting into taller pots and renewing the well-draining mix every two to three months, or when the plants are twice as tall as their pots.
- As the plants get older, repot them yearly into taller pots for proper root formation. Do not allow the roots to become root-bound at any time.
- Move them out into full to partial sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in about one to two years, when the trees have outgrown a 1–3-gallon pots.
- Choose a site in full to partial sun with well-draining soil amended with cinder.
- Water the seedlings in, then water them weekly when it is dry until they are well established.
- Foliar feed them monthly and add small amounts of 8-8-8 NPK fertilizer every three to six months depending on the rainfall and the health of the plant.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your māhoe; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

S

SAPINDACEAE

(SOAPBERRY FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Dodonaea	**'A'ali'i; kūmakani**	*D. viscosa*	—	ind (HI) coastal to subalpine shrubland

Full Sun – Partial Sun

Range
Hawaiian Indigenous

Description
shrub to tree

Propagation
seeds, air-layering, and cuttings



***Dodonaea viscosa* seed capsules — HB**

GENERAL DESCRIPTION

Dodonaea occur in the wild from sea level to the high mountains. They grow as a many-branched, changeable shrub or tree, 1–30 feet tall. They will become more tree-like if given more shade and moisture. The narrow, short leaves are alternate and 1–4 inches long. The young leaf tips contain tannin, resins, were boiled and used for skin aliments by the early Hawaiians (Whistler 1992). Small inconspicuous greenish or red flowers form in clusters at the leaf axils or branch tips. They are unisexual, with either male or female flowers on the same plant or on different plants. The seed capsules are paper-thin, and are tan to dark red. They have two to four broad-winged angles that embody separate cells each containing a small round blackish seed. These attractive capsules were used in lei making and also to make a red dye. The dense, golden-brown hardwood was used for timber, weapons, and tools. These plants are good for a strong hedge, resistant to drought and wind. It is also good as an ornamental plant that can be trimmed and shaped to have a single trunk.

Entire Range: Pantropical-indigenous to Australia and all of the main islands of Hawai'i exc. Kaho'olawe

Wild Habitat: From coastal dunes, shrublands, dry, mesic and wet forests, to subalpine shrublands

Habit: Shrubs to small trees

Mature Height: 0.3–9 m height

Stem/Trunk: Stems are many branched, slender and straight, and the bark is reddish-brown to gray or blackish gray, and more or less sticky

Leaves: The leaves are variable: they are simple with entire margins, oval with pointed ends, papery to somewhat leathery, anywhere from 2–15 cm long by 0.5–6 cm wide. The leaves can be sticky to smooth, or sometimes with a slight covering of fine hairs, especially near the veins; they are green to mottled with red

Inflorescence/Flower: The flowers are unisexual, and the plant may have both male and female flowers on it or only male flowers; the flowers are lacking petals, in paniculate inflorescences, about 1–5 cm long, four sepals, eight stamens, female flowers have two to four styles

Fruit: The fruits are winged capsules, varying from a straw color to a rich, varnished red to purple; they can be compressed or inflated, two to four cells

Seed: Small, hard, dark, round seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are dry and tan or reddish and shedding from the plant.
- Keep them dry in a paper bag until they are ready to be cleaned.
- Separate the small black seeds from the capsules as directed for small dry seeds.
- The seeds can be stored in desiccation or at room temperature for up to eight years, however, it is best to start them fresh to achieve higher germination rates.
- Soak the seeds in hand-hot or tap water for twenty-four hours. The seeds will sink if they are viable; discard any floating seeds after the soaking time is up.
- Surface sow the small seeds onto a mix of 3 parts perlite to 1 part potting mix or fine black cinder (3:1).
- Keep them moist, water them in, and then water every other day.
- Keep them in a covered area protected from heavy rains, which can disturb the seedlings.

GERMINATION

- Germination of all viable seeds can occur in two weeks to six months.
- Wait until four true leaves develop before transplanting them into 2-4-inch pots with a well-draining mix.
- The seeds take turns sprouting; it is best to remove the seedlings as they germinate and keep the flat intact as more continue to germinate.
- Repot them into larger pots and new mix when they are twice as tall as their pots.
- Foliar feed them monthly, and move them into full sun to help harden them off and prepare them for outplanting.

CUTTINGS AND AIR LAYERING

- Both of these methods work. However, I have found that by growing from seeds you can produce more plants that are stronger in the long run. I recommend propagation by seed unless seeds are not available.

OUTPLANTING

- Your *Dodonaea* will be ready for outplanting in about six months to a year or when they have outgrown a 6-inch to 1-gallon pot.
- Choose a site in the full to partial sun (they will grow taller in the shade).
- Amend the hole and soil to create a well-draining site by adding cinder or other coarse materials.
- *Alectryon* or *Sapindus* make excellent companion plants with a single or several *Dodonaea*.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Dodonaea*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

S

SAPINDACEAE

(SOAPBERRY FAMILY)

GENUS:

Sapindus

HAWAIIAN NAMES:

Āulu; lonomea; kaulu

SPECIES	STATUS	HAWAIIAN RANGE
S. oahuensis	—	end (K, O)

HAWAIIAN NAMES:

A'e; mānele

SPECIES	STATUS	HAWAIIAN RANGE
S. saponaria	—	ind (H)

Full Sun – Partial Sun

Range
Endemic or Indigenous[1]

Description
tree

Propagation
seeds

1: Range differs for each species.



***Sapindus oahuensis* flowers — GKL**

GENERAL DESCRIPTION

Sapindus oahuensis is a small tree 20–30 feet tall occurring in dry to mesic forests. They have simple leaves (in one piece) whereas other *Sapindus* species (*S. saponaria*) have even, pinnately compound leaves with three to six pairs of leaflets. The younger branches of *S. oahuensis* are covered with yellowish-brown hairs (tomentum); the dark green oblong leaves have yellow midribs. Small whitish flowers develop along branched spikes at the branch ends that are also hairy. These ripen into 1 inch long, dark leathery fruits that contain one large, blackish seed each. These seeds are used in seed leis and have medicinal qualities as a laxative. The grayish wood was used for weapons and house building. This is an easy enough tree to grow and maintain in the landscape. The seeds need to be cleaned and scarified for speedy germination.

Entire Range: *S. oahuensis* endemic to Kaua'i and O'ahu; *S. saponaria* indigenous to Mexico, South America, the Pacific Basin, Pacific Islands, New Caledonia, Africa; in Hawai'i it occurs on the island of Hawai'i

Wild Habitat: Mesic to dry forests

Habit: Large to medium trees

Mature Height: 6–25 m height

Stem/Trunk: Bark is dark gray and covered with spongy areas in the bark (lenticels), young branches have a yellowish-brown covering of hairs (*S. oahuensis*); bark is a pale brown, fissured and pieces fall off like large scales from the older trees (*S. saponaria*)

Leaves: Leaves simple, yellow midrib, entire, thick-papery, smooth and leaves oval and tapering at the apex; leaf stalks 10 cm long (*S. oahuensis*); or compound (*S. saponaria*), with three to six pairs of papery leaflets, each leaflet is long-oval and tapering at the tips, margins are entire and slightly undulate; leaf stalks about 5 cm long

Inflorescence/Flower: Flowers are small, unisexual: male and female flowers occurring on the same plant (monoecious); they are bilaterally symmetrical, and grow in terminal, paniculate inflorescences. The flowers are in multiples of five with five petals, a nectary disc; the male flower has eight stamens. In female flowers the stigma is 3-lobed, 3-celled, with one ovule per cell.

Fruit: Fruits are fleshy, round, and leathery

Seed: Seeds are round, black, or reddish-brown, about 1–2 cm long. (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Sapindus oahuensis* fruit—JO**

- To propagate by seed, first collect the large, blackish fruits when they are mature and shedding from the plant.
- Keep them moist in a plastic bag until they are ready to be cleaned.
- Remove the pulp by hand or as recommended for large pulpy seeds.
- The seeds can be stored in the refrigerator or in desiccation for about one year, but you will have better viability if you start them fresh.
- Scarify the cleaned seeds with clippers or a file for the germination to be more uniform.
- Or soak the seeds in hand-hot or tap water for twenty-four hours.
- Sow the seeds onto a mix made of 3 parts perlite to 1 part potting mix (3:1), then cover with an additional 1 inch of mix and them water in.
- Keep them in a covered area and water every other day.

GERMINATION (fast-growing)

- Germination of all viable seeds may take three weeks to six months; scarified seeds will sprout sooner and more uniformly than soaked seeds.
- Wait until at least four true leaves develop, then transplant the seedlings into tall 3-4-inch pots allowing room for the root to grow down into the pot.
- Start to foliar feed monthly.
- Repot them into taller and larger pots with new media every couple of months or when they are twice as tall as their pots. Do not allow them to become root-bound (when the roots circle the bottom of the pot).
- Move them into full to partial sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in one to two years, when they are growing healthily and have outgrown a 1- to 3-gallon pot.
- Choose a site in full or partial sun with well-draining soil; amend it as recommended.
- Water your plants in, then water when it is dry until they are well established. To prevent stem rot, make sure the plant is planted out at the same depth as it was in the pot.
- Plant them with other plants and shrubs such as *Dodonaea*, ferns and ground covers.
- Continue to foliar feed and add small amounts of 8-8-8 NPK fertilizer every three to six months depending on the rainfall for healthy growth.

PESTS

- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Ants and their associated pests (scale, mealybugs, thrips, and aphids) can infest your *Sapindus*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

S

SAPOTACEAE

(SAPODILLA FAMILY)

GENUS:

Planchonella (syn: *Pouteria*)

HAWAIIAN NAMES:

ʻĀlaʻa; āulu; kaulu

SPECIES	STATUS	HAWAIIAN RANGE
P. sandwicensis	—	end (HI exc. Ni, Ka)

Full Sun – Partial Sun

Range
Hawaiian Endemic

Description
shrub or tree

Propagation
seeds



P. sandwicensis – Lanaʻi — CC

GENERAL DESCRIPTION

ʻĀlaʻa grows in dry to mesic forests as large shrubs or trees 20–50 feet tall depending on the habitat. It is easily recognized by the rusty red color of the new shoots and undersides of the older leaves. You will also notice the plant extruding milky white latex and the large, round, yellow fruits. The thick, leathery alternate leaves 2–6-inches long are shiny green on the upper surface. Small, pale-green flowers are borne at the leaf axils individually or in dense clusters. Hawaiians used the plant's sticky latex to trap and release small birds for their colorful feathers. The hard yellowish wood was used to make tools and weapons and for house construction (Wagner et al. 1990).

Entire Range: Hawaiian endemic

Wild Habitat: Dry to mesic and diverse mesic forests

Habit: Shrubs or trees

Mature Height: 6–15 m

Stem/Trunk: Young shoots pale gray, cracked or scaly, with white latex, and golden or rusty hairs coating the stems, becoming smoother with age

Leaves: Leaves alternate, thick leathery to thick papery leaves, oblong with blunt ends, about 10 cm long by 5 cm wide; conspicuous veins, upper leaf surface smooth and glossy, undersides covered with whitish golden or reddish hairs. Leaf stalks about 4 cm long



***P. sandwicensis* fruit —JO**

Inflorescence/Flower: Flowers perfect, small, five sepals, five stamens, ovary five-celled, corolla tubular, nectary disc, pale green, and cup-shaped, and borne from axils

Fruit: Fruit yellow to orange, or purplish-black, round, and about 5 cm long

Seed: Seeds one to five, about 3 cm long, compressed laterally, with a smooth and shiny seed coat, about 1–2 mm thick with a full length, narrow scar and a thin embryo (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are yellowish, soft and shedding from the trees.
- Keep them moist in a plastic bag until they can be cleaned.
- Remove the thick yellow pulp by hand, or as directed for large pulpy seeds.
- Also remove the thin membrane left around the seeds by hand.
- Start the seeds fresh for best results.
- To pretreat, soak the seeds in hand-hot or tap water for twenty-four hours
- Add a fungicide to the water for the last five to ten minutes
- The viable seeds will sink.
- Sow the seeds in shallow flats filled with a mix of 3 parts perlite to 1 part potting mix (3:1), and then cover the seeds with an additional ¼ inch of potting mix.
- Keep them in a covered area protected from harsh weather.
- Water them every other day.

GERMINATION (slow)

- You can expect germination of all viable seeds within two to six months.
- Wait until four true leaves develop, then begin foliar feeding monthly.
- Transplant them into a 3–4-inch pot with well-draining cindery mix.
- Repot them into taller, larger pots every five to ten months; be careful as you transplant not to damage the roots.
- Move them into partial to full sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- Your ʻālaʻa will be ready to outplant in about one year or when it has outgrown a 1 or 2-gallon pot.
- Choose a site with full to partial sun in well-draining soil and amend with cinder of needed.
- Water them in, and then water when it is dry until they are well established; keahi are from drier habitats in the wild.
- Outplant with other plants, such as shrubs like *Dodonaea*, ferns, and ground covers.
- Foliar feed them monthly with a regular solution and add small amounts of 8-8-8 NPK fertilizer every three to six months depending on the amount of rainfall.

PESTS

- Ants and their associated pests (scale, mealybugs, thrips, and aphids) can infest your ʻālaʻa; the aphids and thrips will feed on the plant juices (sucking insects). Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant to a systemic pesticide.

S

SAPOTACEAE

(SAPODILLA FAMILY)

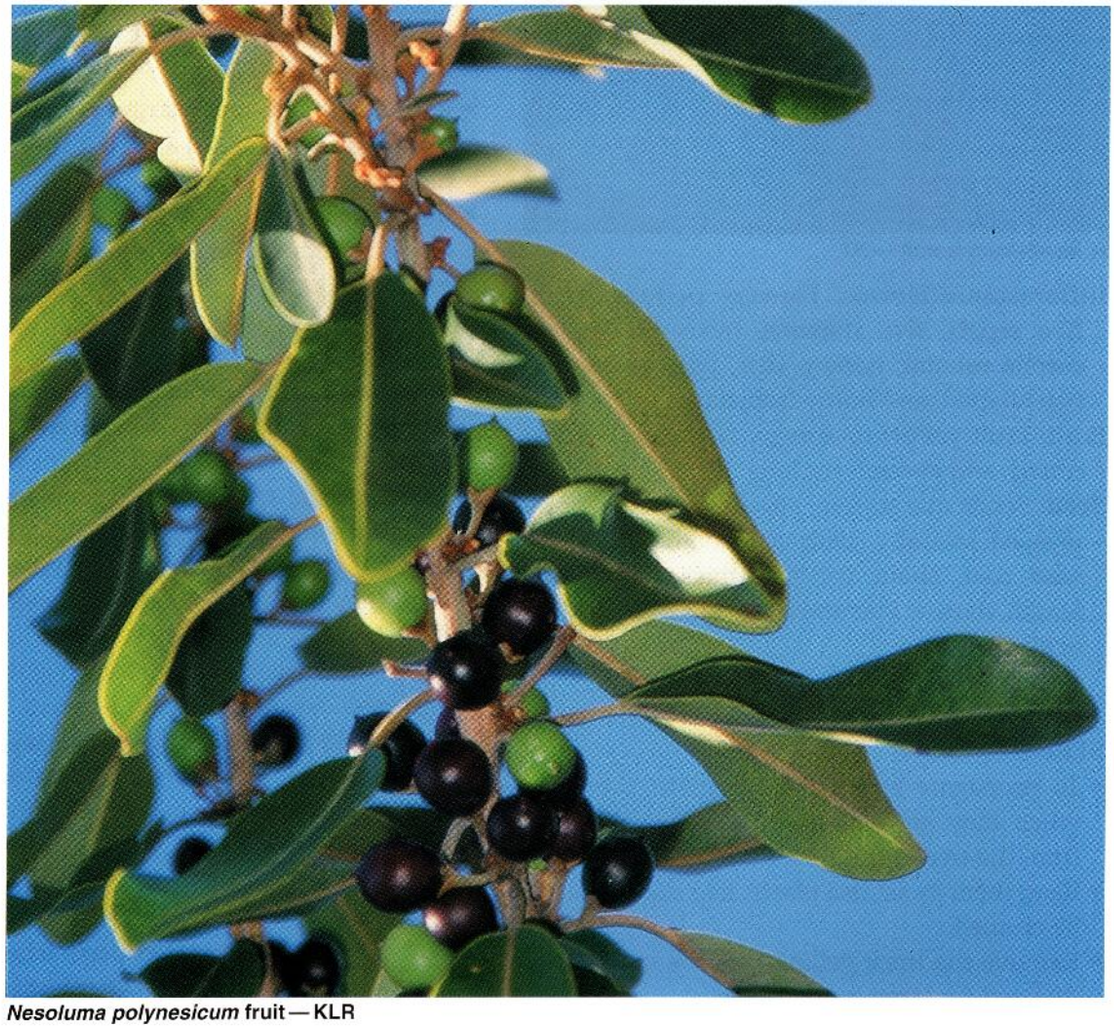
GENUS:

Sideroxylon (syn: *Nesoluma*)

HAWAIIAN NAME:

Keahi

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
S. polynesicum	V	ind (HI exc. Ni, Ka) dry to mesic forests



Nesoluma polynesicum fruit — KLR

Full Sun – Partial Sun

Range
Indigenous

Description
shrub to tree

Propagation
seeds

GENERAL DESCRIPTION

Keahi occurs as a large shrub or medium-sized tree with gray-brown bark that releases a white latex. The short leaves are leathery, flexible, and oblong; new shoots and the underside of leaves are covered with a brown tomentum (woolly hairs). Small, fragrant, whitish, unisexual flowers develop along the stems. Male or female flowers develop on different plants, and two or more plants are required to produce viable seeds. Shiny purplish rounded fruits are borne along the branches just below the foliage; the fruits contain one oblong brown seed. Keahi is a reasonably easy tree to grow. It has high germination rates from fresh viable seeds and it is easily maintained in the landscape with few insect problems.

Entire Range: Indigenous to Austral Islands, Rapa, and in Hawai'i: all of the main islands exc. Kaho'olawe

Wild Habitat: Occurs in dry forests, slopes, lava fields, and remnant patches of dry forest

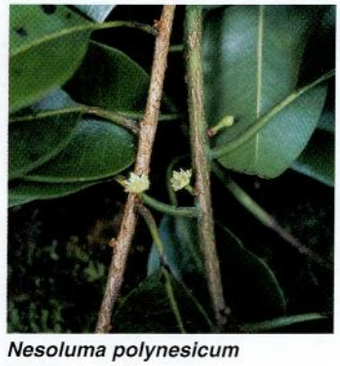
Habit: Dioecious (male or female) shrubs or trees

Mature Height: 10 m height

Stem/Trunk: Trunks, stems 25 cm in diameter, cracked and sometimes scaly, rough gray or brown bark, white latex; young shoots grayish brown and covered with dense brownish hairs, becoming smoother with age

Leaves: Leathery leaves, elliptical, about 7 cm long by about 3 cm wide,

Inflorescence/Flower: The flowers are scented, each plant is male or female (there may be perfect flowers, but it is not known how consistently this occurs), in inflorescences from the leaf axils and coming off of the stem below the leaves, the base of the inflorescence is persistent after fruiting, sepals whorled and four to five, corolla pale whitish or green, flowers tubular, nectary disc absent, superior ovary in females



Nesoluma polynesicum **flowers — JO**

Fruit: Fruit is a berry, reddish to purple-black when mature, smooth, oval to round about 1–2 cm long and sometimes beaked

Seed: Seeds one per fruit, about 1 cm long, not laterally compressed, the scar is broad, and the seed coat is shiny (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate from seed, first collect fruit when they are purple-black; keep them moist in a plastic bag until they can be cleaned.
- Separate the pulp from the seeds as directed for medium pulpy seeds.
- Seeds can be stored in desiccation, but for high germination rates use fresh seeds.
- To pretreat, soak the seeds in hand-hot or tap water for forty-eight hours. If the seeds crack open before the time is up, stop soaking them and sow the seeds right away.
- Sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), then cover them with an additional ¼ inch of mix, and water them in.
- Keep them in a covered area protected from heavy rain, which can damage the seedlings.
- Once the seedlings start to sprout, foliar feed them monthly with a light solution.

GERMINATION

- Germination of all viable seeds will take approximately one to six months.
- Wait until two to four true leaves form before transplanting them into 4-inch pots using a well-draining mix.
- Add a small amount of 8-8-8 NPK fertilizer to the mix and water them in.
- Continue to foliar feed them monthly; repot them into larger pots in four or five months.
- Move your seedlings into full sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- Your keahi will be ready to outplant in about one year or when it has outgrown a 1–2-gallon pot.
- Choose a site with full to partial sun in well-draining soil and amend with cinder if needed.
- Water them in, and then water when it is dry until they are well established; keahi are from drier habitats in the wild.
- Outplant keahi with other plants, such as shrubs like *Dodonaea*, ferns, and ground covers.
- Foliar feed them monthly with a regular solution and add small amounts of 8-8-8 NPK fertilizer every three to six months, depending on the amount of rainfall, for rapid, healthy growth.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your Keahi; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- The black twig borer bores holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.

S

SCROPHULARIACEAE

(FIGWORT FAMILY)

GENUS:
Bacopa

HAWAIIAN NAME:
'Ae'ae

COMMON NAME:
Water hyssop

SPECIES	STATUS	HAWAIIAN RANGE
B. monnieri	—	ind (HI exc. Ka) wet coastal areas

Full Sun – Partial Sun

Range
Indigenous

Description
herb and ground cover

Propagation
cuttings



***Bacopa monnieri* flowers — KJ**

GENERAL DESCRIPTION

Bacopa is a creeping, succulent, perennial herb that is very adaptable to different habitats. They make a great ground cover, doing best when planted where they have their feet (roots) wet. This plant easily roots at the nodes, stabilizing the soil and deterring erosion; it grows into thick aquatic mats on or near marshes or brackish water streams; it even thrives on dried sandstone. The small, spatula-shaped, fleshy, opposite leaves are light green. Single pale-blue flowers develop from the leaf axils on top of long spikes; these form into small ovoid capsules containing tiny brown seeds. These plants are very easily propagated at any time of the year by collecting herbaceous cuttings. When using this plant as a ground cover, make sure you give it lots of room to roam. They have the tendency to take over an area if the soil is healthy and kept moist. I have some growing at 300 feet elevation and I need to keep trimming them away from growing up the hāpu'u tree trunks.

Entire Range: Widespread in tropical and subtropical regions; Hawai'i: Midway Atoll, all main islands exc. Kaho'olawe.

Wild Habitat: Occurs along coastal areas, mudflats, sand, bare sandstone, rocks, marshes, shores, or brackish streams

Habit: Perennial herb, semiaquatic

Mature Height: 1–6 dm long

Stem/Trunk: Prostrate stems, which root at the nodes and form mats

Leaves: Leaves opposite, with entire margins, fleshy spatulate leaves, and short leaf stalks

Inflorescence/Flower: Flowers are bell-shaped, solitary, with five lobes, corolla white to lilac or pale blue, and smooth, with two bracts beneath it. Flowers grow out of the leaf axils with the flower stalks up to 20 mm long

Fruit: Fruits are round capsules about 8 mm long and membranous

Seed: The seeds are numerous, pale brown, oblong, about 0.5 mm long, and with longitudinal ridges (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

CUTTINGS

- To propagate by cuttings, first collect herbaceous stem cuttings during the morning hours; keep them moist in a sealed plastic bag until they can be started; follow protocols for herbaceous stem cuttings.
- Remove the lower leaves, and cut the stems into 5-inch pieces, placing the bottom end under ½ inch of a mixture of 3 parts perlite to 1 part potting mix (3:1), and water them in. No rooting powders are needed.
- Do not allow the mix to dry out; water them every other day, and they will develop roots in one to two months.
- Transplant the rooted cuttings one to three per 4-inch pot into a well-draining mix; water them in.
- Keep them in a shaded area for two weeks, then move them into full to partial sun to help harden them off.
- They will be ready for outplanting in five to six months.
- Foliar feed them monthly for strong, healthy growth.
- Large dug up clumps can be planted right into the ground; first, loosen the ground and cover the plants lightly with soil, then keep them moist until the roots become well established in the ground.

OUTPLANTING

- Choose a site in full to partial sun with moist, well-draining soil amended with cinder if the drainage is poor.
- Water them in after planting, and then water them when it is dry until they are well established, with their fast-growing roots holding the unstable soil in place.
- These flat, matted plants will grow to cover a large area, growing up and over other small plants. Simply trim them back if they get out of control.

PESTS

- Slugs may eat the leaves and the fruit; if you discover them, apply slug bait or pick them off by hand.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Bacopa*, these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- This may only be a unique problem on the island of Kaua'i: wild chickens love to dig up the ground around the plants as they look for insects. They destroy the plants in the process because they expose the roots to the sun; the roots dry out and then die. If you have this problem, trap the chickens in live-traps and relocate them.

S

SMILACACEAE

(CATBRIAR FAMILY)

GENUS:
Smilax

SPECIES	STATUS	HAWAIIAN RANGE
S. melastomifolia	—	end (HI exc. Ni, Ka)

HAWAIIAN NAMES:
Uhi; ulehihi; hoi kuahiwi

Shady

Range
Hawaiian Endemic

Description
climbing, woody vine

Propagation
seeds and cuttings



***Smilax melastomifolia* flowers – Kaua'i — KRW**

GENERAL DESCRIPTION

Uhi is a climbing, woody vine with tuberous rhizome-type roots and finely grooved stems equipped with tendrils that help the vine to grow up and over shrubs and trees. It occurs in the mesic to wet forests. Uhi has leathery, dark green, alternate leaves 3–5 inches long with prominent interconnecting veins throughout the stiff, heart-shaped leaf. Small greenish unisexual flowers cluster at the leaf axils along the stems; each plant has either male or female flowers and needs another with opposite-sexed flowers to make viable seeds. Clusters of round greenish fruits turn whitish when mature and contain one to three tan seeds. I feel it is best to grow Hawaiian plants from their mature seeds instead of cutting up the poor, stressed-out plants in the wild. The roots of many *Smilax* species store starch and the roots of *Smilax melastomifolia* may have been utilized as a famine food by early Hawaiians (NTBG).

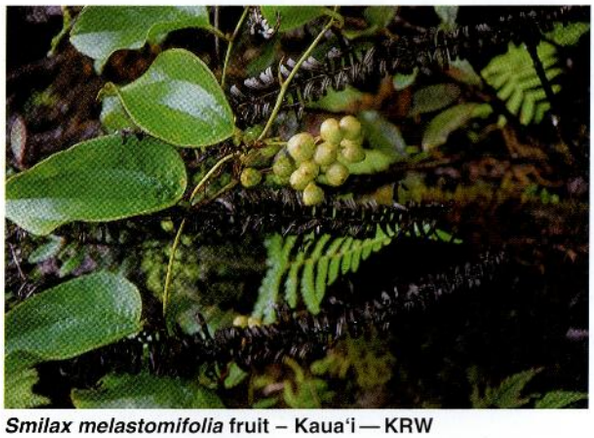
Entire Range: Hawaiian endemic
Wild Habitat: Mesic to wet forests and bog margins
Habit: Liana (woody vine) with tuberous rhizome (underground stems)
Mature Height: Not applicable
Stem/Trunk: Finely grooved stems, smooth to sparsely prickly
Leaves: Leathery leaves, glossy and heart-shaped with parallel veins, entire margins, leaf

stalks twisted and strongly curved with a pair of tendrils near the base

Inflorescence/Flower: Flowers dioecious (female and male flowers on separate plants), in umbels, flowers in multiples of three, six tepals, male flowers with eight to eighteen stamens, female flowers with ovary 3-angled ovules, flowers pendulous

Fruit: Clusters of round berries, about 1 cm in diameter

Seed: Small seeds with a hard endosperm, usually one to three per fruit (Wagner et al. 1990)



Smilax melastomifolia **fruit – Kaua'i — KRW**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the mature white fruit when they are soft and shedding from the vine.
- Keep the berries moist in a plastic bag until cleaned.
- Separate the pulp from the medium seeds as directed.
- Start the seeds fresh for best germination rates; do not store them.
- Soak the seeds in tap water for one hour; the seeds will sink if they are viable.
- Sow onto a mix of 3 parts perlite to 1 part potting mix (3:1) and then cover with ¼ inch of additional mix; water the seeds in.
- Keep them in a covered area protected from heavy rains and full sun.

GERMINATION

- Germination of all viable seeds will take one to six months.
- Wait until the seedlings have two to four true leaves, then transplant them into 2–3-inch pots.
- Use a well-draining mix of 3 parts black cinder to 1 part potting mix (3:1), adding a small amount of 8-8-8 NPK fertilizer.
- Keep them in a partially shaded area and foliar feed them monthly.
- Repot them into larger pots in about three months, when the roots fill the bottom of the pot.

CUTTINGS (tuberous rhizomes)

- Follow directions for tuberous cuttings (pg. 22-23).
- Remove all stems and foliage; keep them moist in a sealed plastic bag.
- Pot them into a mix of 3 parts black cinder to 1 part potting mix (3:1) in a shallow flat or into pots, cover the rhizome with ¼ to ½ inch more of mix, then water them in.
- Keep them in a shaded, covered area.
- Signs of new growth will appear in about two to four months, which indicates that they have rooted.

OUTPLANTING

- Your uhi will be ready for outplanting in about six to eight months, when they have outgrown a 6-inch to 1-gallon pot.
- Choose a cool site in the higher elevations, in the shade of a tree with well-draining, moist soil where the uhi can climb into the tree for adequate support.
- Add small amounts of 8-8-8 NPK fertilizer mixed into the soil every four to eight months depending on the rainfall.
- Water them in and then water when it is dry until your plants are established and growing healthily.

PESTS

- Ants and their associated pests (scales, mealybugs, and aphids) can infest your uhi plants; use a systemic pesticide and control them according to the protocols for ants.
- Keep your plants healthy. Outplanting them in a well-draining nutritious soil will detour harmful exotic insects from invading them.

S

SOLANACEAE
(NIGHTSHADE FAMILY)

GENUS:
Lycium

HAWAIIAN NAMES:
ʻŌhelo kai; ʻaeʻae; ʻākulikuli ʻaeʻae

SPECIES	STATUS	HAWAIIAN RANGE
L. sandwicense	—	ind (Kl, HI)

Full Sun

Range
Indigenous

Description
small spreading shrub

Propagation
seeds and cuttings



***Lycium sandwicense* fruit — DB**

GENERAL DESCRIPTION

ʻAeʻae is a small spreading shrub that grows up to 3 feet tall. It occurs in dry coastal sites, growing among rocks or near brackish marshes. The small, alternate, succulent leaves are singular or clustered along the pale-green stems. Tiny pale-blue tubular-shaped flowers develop at the leaf axils. Red, rounded, fleshy berries that contain many tiny, flat, tan seeds form from the flowers. These plants would make a good ground cover in drier coastal gardens. They are an attractive contrast when planted in a black cinder mound along with other coastal plants such as *Pandanus*, *Dodonaea*, *Sida*, *Capparis*, and *Heliotropium*. *Lycium* is an easy plant to grow and maintain in the landscape when planted in the right environment.

Entire Range: Indigenous to Kaʻula Rock and Hawaiʻi
Wild Habitat: Subsaline and rocky coastal sites, sea level to 40 m elevation
Habit: Spreading shrub
Mature Height: Up to 1 m height
Stem/Trunk: Woody, branching shrub; branches stiff; bark pale and smooth

Leaves: Leaves simple, margins entire, narrow about 3 cm long by 5 mm wide, alternate on main shoots, and densely clustered on lateral shoots, succulent, linear and spatulate; leaf stalks absent

Inflorescence/Flower: Flowers are solitary, growing from the leaf axils, calyx four-lobed, about 4 mm long, with triangular lobes, corolla whitish, bluish to pink, tubular, bell-shaped and about 4 cm long

Fruit: Succulent red berries, round, smooth, and about 8 mm in diameter

Seed: Seeds are small, flat, D-shaped, and numerous (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the red berries when they are soft and can be easily removed from the stems.
- Keep them soft in a plastic bag until they can be cleaned.
- Separate the small flat seeds from the pulp as recommended for small pulpy fruits.
- The cleaned seeds can be stored in the refrigerator or in dried desiccation chambers for up to eight years.
- No pretreatments are necessary for the seeds as they sprout readily.
- Surface sow them onto a dry mix of 3 parts perlite to 1 part potting mix (3:1), and water them in.
- Keep them in a covered area protected from heavy rains and water every two to three days.

GERMINATION

- Germination of all viable seeds will take three weeks to five months.
- Wait until two true leaves develop before transplanting.
- Transplant the seedlings into 2-inch pots filled with media made of 3 parts black cinder to 1 part rinsed sand or potting mix (3:1).
- Water the seedling in.
- Move them into full sun in two weeks.
- Repot them into larger pots as they outgrow their pots.
- Foliar feed your *Lycium* if they turn yellow; this is because they need more nitrogen.

CUTTINGS (herbaceous)

- To propagate by cuttings, follow the directions for collecting herbaceous cutting material.
- Cut each stem into 4-inch pieces, removing all of the lower foliage; no rooting powder is needed.
- Use a mixture of 3 parts perlite to 1 part vermiculite (3:1), or just pure fine black cinder (100 percent). Water when dry.
- Your cuttings will develop roots in about two months.
- Pot them and handle them the same as directed for the seedlings.

OUTPLANTING

- Your *Lycium* will be ready to outplant in about six months or when the plants have outgrown 4–6-inch pots.
- Choose a site in full sun with well-draining soil and amend with cinder if the area needs it.
- *Lycium* can be planted in higher elevations such as 300 feet if the soil provides the proper drainage.
- Foliar feed them monthly if the foliage yellows.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Lycium*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Slugs may eat the leaves and the fruit; if you discover them, apply slug bait or pick them off by hand.

S

SOLANACEAE

(NIGHTSHADE FAMILY)

GENUS:

Nothocestrum

HAWAIIAN NAME:

'Aiea; hālena

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
N. breviflorum	E	end (H) dry to mesic forests
N. latifolium	R	end (HI exc. Ni, Ka, H) dry to mesic forests
N. longifolium	E	end (HI, exc. Ni, Ka) mesic to wet forests
N. peltatum	E	end (K) diverse mesic forests

Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds



Nothocestrum breviflorum **– Hawai'i — SP**

GENERAL DESCRIPTION

Nothocestrum is a genus endemic to the Hawaiian Islands. It is a slow-growing small tree or large shrub found in the mesic forests of the islands. Their simple leaves are alternate and usually clustered at the top of the branches. Small, greenish-yellow, delicately fragrant, tubular flowers develop along the stems. Orangish-red to yellow roundish berries form close to the stem during the winter months containing many small seeds. I have not had success with *N. peltatum* from cuttings. They do not root. This species has tiny green caterpillars in the fruits, which eat the seeds when collected ripe. Air layering in spring on the new growth does work if high rooting powder numbers are used such as 16, 30, or 45.

Entire Range: Hawaiian endemic

Wild Habitat: Dry, wet, mesic to diverse mesic forest

Habit: Stout trees (about 45 cm diameter), small trees to shrubs

Mature Height: Up to 12 m in height

Stem/Trunk: Wood whitish-green, soft, and sappy; bark smooth, brown or gray; trunk gnarled (*N. latifolium*) or slender; branches rigid, growing upward, young stems covered with fine hairs, becoming smoother with age; branches brightly ashen–brown

Leaves: Leaves simple, alternate, margins entire, about 7–20 cm long by about 3–7 cm wide;

oval and narrowing at both ends, leathery, some species seasonally deciduous leaves, upper surface generally smooth, lower surface generally covered with fine hairs, leaf stalks from 1–11 cm long. Leaves usually clustered toward the branch ends

Inflorescence/Flower: Flowers perfect, radially symmetrical, solitary or numerous on short spurs, flower stalks variable depending on species from very short (3–18 mm long) to longer (about 4–30 mm long), flower shape tubular to bell-shaped, four-lobed calyx, greenish-yellow; corolla also greenish-yellow and four-lobed; four stamens, ovary superior



***Nothocestrum* sp. flowers—SP**

Fruit: Fruit is a fleshy berry, yellowish or orange, and about 2–6 mm long. They are round or elliptical (according to species), sometimes completely or partially enclosed by the calyx

Seed: Seeds are numerous, irregular, angular, and about 2.5 mm in diameter (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, first collect the ripe orange berries.
- Keep them moist in a plastic bag until they can be cleaned.
- Remove the small seeds from the succulent pulp as directed for small pulpy seeds.
- The seeds do not maintain their viability when stored. For the best results, start them fresh.
- To pretreat the seeds, soak them in tap water for one hour.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), then cover them with an additional ¼ inch of mix, and water them in.
- Keep them in a covered area, protected from heavy rains.
- Once the seedlings sprout, begin to foliar feed them monthly using a weakened solution.

GERMINATION (slow-growing)

- Germination of all of your viable seeds will take about one to six months.
- Wait until four to six true leaves develop, then transplant them into 2-inch pots.
- Keep the seed flat intact because more seeds will continue to sprout until all of the viable ones have germinated.
- Use a well-draining cindery mix with a small amount of 8-8-8 NPK fertilizer.
- Keep them in a partially shaded area.
- Repot them into larger pots in five to six months.
- Move them into partial sun to help harden them off and help prepare them for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in one to two years, or when they have outgrown a 1–2-gallon pot.
- Choose a site with well-draining soil and amend it with cinder for proper drainage if needed.
- Make sure you plant *Nothocestrum* at the same soil level it was in the pot.
- Water them in, and then water when it is dry until they are well established and growing healthily. They will grow slowly at first.
- *Nothocestrum* are best planted with other plants, such as ground cover or small shrubs, which provide added protection.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) that they farm can infest your *Nothocestrum*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Root mealybugs can infest the roots of your plant; if they do, apply a diluted soil drench with neem oil or other horticultural oils.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly, water the plants first to reduce any stress.

S

SOLANACEAE
(NIGHTSHADE FAMILY)

GENUS:
Solanum

HAWAIIAN NAMES:
Pōpolo; pōpolo kū mai; ʻākia; pōpolo ʻaiakeakua

COMMON NAME:
(*S. incompletum*) Thorny popolo

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
S. incompletum	E	end (K, Mo, L, M, H) dry to subalpine forests
S. nelsonii	V	end (HI exc. L, Ka) coastal sites
S. sandwicense	E	end (K, O) diverse mesic forests

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
large shrub to ground cover

Propagation
seeds and cuttings



Solanum incompletum – Hawaiʻi — SG

GENERAL DESCRIPTION

All the Hawaiian *Solanums* (tomato family) are endangered and threatened in the wild by the destruction and degradation of their habitats.

The thorny popolo or popolo ku mai (*S. incompletum*) is a small shrub, armed with soft red thorns, once occurring in a wide range of habitats from dry to subalpine forests.

The popolo (*S. nelsonii*) grows as a low clumping ground cover in drier coastal sites. Their gray-green leaves and stems are covered with very fine velvety hairs, that reflect the harsh sun and salt spray.

The Popolo ʻaiakeakua (*S. sandwicense*) is a large sprawling shrub, covered in tiny, yellow-brown hairs, and small black pulpy fruit when in season. The simple leaves are arranged alternately and change in appearance from the juvenile to mature stages. Small whitish flowers develop from the leaf axils. These develop into succulent orangish to blackish berries that contain many small, tan, flattened seeds. These plants are rare in the wild and are sensitive to attacks from introduced insects. The seeds are easy to germinate, and cuttings root readily. The problem with these plants is keeping the insects away and controlling the red spider mites, root-knot nematodes, and whiteflies, which are just a few of the worst pests.

Entire Range: Hawaiian endemic

Wild Habitat: Dry to mesic, diverse mesic to subalpine forests; coastal sites and coral rubble

Habit: Shrubs armed with prominent reddish prickles (*S. incompletum*), or sprawling to trailing shrubs that are unarmed

Mature Height: 1–4 m in height, some sprawling

Stem/Trunk: Young stems and leaves covered with dense hairs that appear star-shaped

Leaves: Leaves simple, alternate, leaf shape variable according to species, some degree of leaf surface covered with fine hairs, leaf stalks present; the leaf form changes from juveniles to mature plants

Inflorescence/Flower: Flowers perfect, radially symmetrical, flower parts in multiples of five, flower bell-shaped, when the petals open the flower appears to be star-shaped; flowers occurring in various forms of cymes with the inflorescence terminal and becoming axillary; flowers white, some tinged with pink to purple, and all with a dense or sparse covering of hairs; five stamens, anthers yellow, and ovary superior

Fruit: Fruits are pulpy round berries, red, and orange to black when ripe, 1–2 cm in diameter

Seed: Seeds are numerous, flattened, and tan (Wagner et al. 1990)

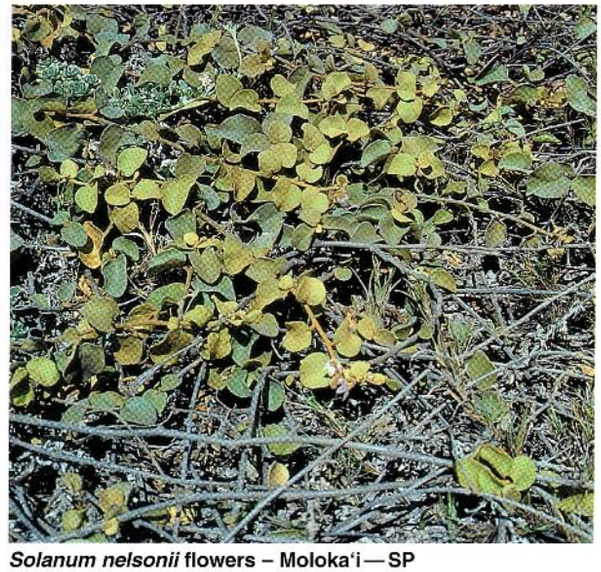
PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the berries when they are soft and blackish to orange.
- Keep them moist in a plastic bag until they can be cleaned.
- Remove the flat, tan seeds by hand, or as directed for medium pulpy seeds.
- Seeds can be stored in the refrigerator or *S. nelsonii* in desiccation for up to eight years, losing some viability.
- To pretreat the seeds, soak them in tap water for one hour, and then air-dry them.
- Sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), and then cover them with ¼ inch of additional mix, water them in.
- Keep them in a covered area protected from heavy rains.
- Once the seedlings sprout start to foliar feed them monthly with a light solution.

GERMINATION

- All of your viable seeds will germinate within one month to a year.
- Wait until four true leaves develop before transplanting; then transplant into 2–4-inch pots depending on root size.
- Use a well-draining mix with a small amount of 8-8-8 NPK fertilizer mixed in, then water them in.
- Keep them in partial shade for a few weeks, then move them into more sun.
- Repot them into larger pots after three months.
- They are fast-growing at the juvenile stage; their growth slows down with age.
- Repot them annually, with a well-draining soil mix.



***Solanum nelsonii* flowers – Moloka'i — SP**

CUTTINGS

- To propagate clonally by cuttings, collect the green tip cuttings in the cool morning hours. Springtime and early summer are the best seasons to take cuttings.
- Keep them moist in a sealed plastic bag.
- Remove all lower foliage.
- Treat them with rooting powder Nos. 1 or 3 (Hormex®); no rooting powders are needed for *S. nelsonii*.
- They should develop roots in two to four months (*S. nelsonii* may root in one month).
- Pot up and handle the cuttings the same as directed for the seedlings.



***Solanum sandwicense* flowers & fruit — SP**

OUTPLANTING

- Your *Solanum* plants will be ready for outplanting in one to two years or when they have outgrown a 1–2-gallon pot (*S. nelsonii* may take six months plant as a ground cover in a cinder or sandy mound).
- Choose a site with well-draining soil; amend with a nematocide to prevent root-knot nematodes from killing your plants (*S. sandwicense*), follow the manufacturer's instructions.
- Water them in, and then water when it is dry until they are well established.

PESTS

- Leaf miners can leave their trails on your leaves; if you discover them, remove all affected foliage.
- The black twig borer will bore holes in the thin stems, which kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Your plants can be susceptible to sucking insects such as scales, aphids, mealybugs, thrips, and mites. To treat them spray your plants with horticultural oil.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly, watering the plants first to reduce any stress.
- Root mealybugs can infest the roots of your plant; if they do, apply a soil drench with neem oil or other horticultural oils.
- Root-knot nematodes are sometimes drawn to your *Solanum* roots; if you see signs of them, such as root knots, apply nematocides to the soil around your plant.
- Whiteflies can infest the undersides of the leaves; if they do, wash them off with a strong spray of water, or treat them with horticultural oil and/or systemic pesticides.
- Ants can infest your Solanum. Use bait for the ants according to the protocols for ants.
- Mice and rats will eat the seeds in the wild and in cultivation; to control them, use bait and traps.

THEACEAE

(TEA FAMILY)

GENUS:	HAWAIIAN NAMES:	SPECIES	STATUS	HAWAIIAN RANGE
Eurya	Ānini; wānini	*E. sandwicensis*	R	end (K, O, Mo, M, H)

T



***Eurya sandwicensis* fruit – Kaua'i — SP**

Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds

GENERAL DESCRIPTION

Eurya occurs in diverse mesic to wet forest as small evergreen trees or in the wild as sprawling shrubs. They grow 6–20 feet in height, with closely spaced, small, oblong leaves that are finely toothed along the edge and networked throughout with prominent red veins. The small, yellowish, fleshy flowers develop from the leaf axils, and ripen into the rounded black berries that contain about ten small seeds. These also resemble the fruit of *Myrsine* (kōlea). Viable seeds germinate readily, but the young plants need a cool, moist environment to grow well. Cuttings root poorly, if at all, and are feeble.

Entire Range: Hawaiian endemic

Wild Habitat: Found in mesic to wet diverse mesic forests

Habit: Small evergreen tree or shrub, in windswept regions it can be sprawling

Mature Height: 2–6 m long

Stem/Trunk: Branchlets have a covering of straight hairs

Leaves: Leaves are alternate, toothed, dense, leathery, elliptic with the ends narrowing, about 7 cm long by 3 cm wide, with reddish veins, upper surface smooth, lower surface with conspicuous veins; the leaf stalks are short, about 2 mm long

Inflorescence/Flower: Flowers are male or female and the plants usually have both flowers on the same plant; flower parts in multiples of five; one to two flowers grow out of the



E. sandwicensis **– Maui—F&KS**

leaf axils, nodding, with two bracts, five sepals, five small pale-yellow to cream petals, about 5–6 mm long and fleshy; flower stalks only 5 mm long

Fruit: Fruit is a round, fleshy berry, ripening to a dark bluish-black, about 9 mm in diameter

Seed: Seeds are numerous and small (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the dry black berries when ripe and shedding from tree.
- Separate the small seeds from the berries as directed for small pulpy fruit.
- Do not store the seeds or they will lose their viability.
- No seed pretreatments are necessary.
- Surface sow the seeds onto a mix of 3 parts fine black cinder to 1 part potting mix or 1 part peat moss (3:1), keep them in an intermittent mist system that is on during the daylight hours.
- Or, keep them moist in a covered, shaded area.
- Water them every other day.

GERMINATION

- Germination of all viable seeds will occur in one to four months.
- Wait until four true leaves develop, then carefully transplant the seedlings into 2-inch pots.
- Use a well-draining mix of 2 parts black cinder to 1 part potting mix (2:1) with small amount of 8-8-8 NPK fertilizer mixed in.
- Keep them in a cool, moist, shaded area.
- Foliar feed them monthly with a light solution.
- Repot the seedlings into larger pots when they grow twice as tall as their current pots.
- Move them into partial sun to help harden them off and prepare them for outplanting.

OUTPLANTING

- Your plants will be ready for outplanting in about one year, when they have outgrown a 1-gallon pot.
- Choose a site with partial shade and out of strong drying winds with well-draining soil.
- Amend the soil if needed with cinder for proper drainage, and mix in a small amount of 8-8-8 NPK fertilizer.
- Water the plants in, then water when the soil is dry, until they are well established and growing healthily.
- Monitor them closely for poor drainage and new growth, make sure your *Eurya* are not planted too deep; the base of the plant should be at the same depth it was in the pot.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Eurya*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

THYMELAEACEAE

('ĀKIA FAMILY)

T

GENUS:	HAWAIIAN NAME:
Wikstroemia	**'Ākia, kauhi**

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
W. bicornuta	R	end (L, M) wet forests
W. forbesii	—	end (Mo) wet forests
W. furcata	—	end (K) diverse mesic forests
W. hanalei	Ex?	end (K) wet forests
W. monticola	—	end (M) dry lava
W. oahuensis var. *oahuensis*		end (K, O, Mo, L, M) mesic forests to bogs
W. oahuensis var. *palustris*		end (K)
W. phillyreifolia	—	end (H) dry forests to alpine
W. pulcherrima	—	end (H) dry forests
W. sandwicensis	—	end (H) dry to wet forests
W. skottsbergiana	Ex	end (K) mesic to wet forests
W. uva-ursi var. *kauaiensis*	—	end (K) dry areas
W. uva-ursi var. *uva-ursi*	—	end (O, Mo, M) dry areas
W. villosa	Ex	end (M) wet forests

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
ground cover, shrub or tree

Propagation
seeds and cuttings

1: Sun requirements differ for each species.



***Wikstroemia uva-ursi* flowers and fruit — DR**

GENERAL DESCRIPTION

Native 'ākia occur scattered in the dry forests up to high alpine zones. They are low-growing subshrubs or small trees. Depending on the species and its habitat, the dark green or gray-green, shiny, opposite leaves are either small and ovate or large and narrow. Clusters of tiny, yellow, tubular, fragrant flowers develop at or near the branch ends from the leaf axils. The fruit ripens into round, pulpy, orange or red fruits, which are bird dispersed. There is one small blackish seed per fruit that is pointed at one end and has a somewhat hard seed coat, which protects the embryo. The roots and bark of *W. oahuensis* are believed to be poisonous (Stokes 1921, Degener 1945); Hawaiians used it to stupefy fish in small



***Wikstroemia oahuensis* fruit — JO**

ponds. This is one of the few native Hawaiian plants with known active alkaloids. The Hawaiians used these plants occasionally for cordage; the fruit was used in leis, medicinally as a laxative and to treat asthma, and the softwood was used to make carrying sticks, called 'auamo (Abbott 1992). This is a very easy plant to grow from mature seeds. Cuttings will root, but they take a little more effort to get them to root properly and readily. 'Ākia is an attractive plant when used in the landscape with its many brightly colored fruits and gray-green foliage.

Entire Range: Hawaiian endemic

Wild Habitat: From dry forests to alpine zones

Habit: The habit is variable depending on the species; they can be prostrate, sprawling shrubs, subshrubs, or small trees

Mature Height: Variable from 1–10 m height

Stem/Trunk: Stems and branches have very strong fibers. Young branches may be covered with fine hairs or they may be smooth

Leaves: Leaves are opposite; the shape is variable from elliptic to oval, leathery, pale gray-green to dark green

Inflorescence/Flower: The flowers are perfect or unisexual, radially symmetrical, small, at stem apices or growing out of the leaf axils, flowers in inflorescences, calyx is four-lobed, flowers are tubular, petals are absent, and a nectary disk is present

Fruit: The fruit is an attractive, oval to round, pulpy drupe, which can be various shades of red to orange-red

Seed: There is one seed per fruit; they lack endosperm, have a hard seed coat, and are pointed at one end (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the mature orange or red fruit when it is soft and shedding from the plant.
- Keep them moist in a plastic bag to help make the cleaning easier.
- Separate the pulp from the seeds as recommended for medium pulpy seeds.
- Start the seeds fresh to achieve higher germination rates.

- To pretreat the seeds, soak them in tap water for twenty-four hours.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), water them in.
- Keep them in an area covered and protected from heavy rains.
- Water every other day or when dry.

GERMINATION

- All viable seeds will germinate in three weeks to five months.
- Sometimes a few seedlings will be completely white (albino) and short-lived because they do not have chlorophyll and cannot convert sunlight into food for the plant.
- Before transplanting the seedlings, wait until four true leaves develop.
- Transplant the seedlings into 2–4-inch pots, depending on the size of the root ball.
- Use a well-draining mix made of cinder, potting mix, and perlite.
- Repot them into larger pots when the seedlings are twice as tall as their pots.
- Keep them in the shade for a few weeks, then move them into more sun.
- The species from alpine zones, such as *W. phillyreifolia*, need to be cool and dry; the wet-forest species, such as *W. bicornuta* and *W. forbesii* need to be kept wetter and in a shady area; *W. uva-ursi* needs to stay drier and in full sun; this species is most commonly used in the landscape as a ground cover.

CUTTINGS

- To clonally propagate ʻākia by cuttings, collect the semi-hardwood tip cuttings about 4–5 inches long in the cool morning hours.
- Remove all lower foliage.
- Keep them moist in a sealed plastic bag until you start them.
- Remove ¼-inch ring of the bark of the bottom end of the cuttings, then dip the end into rooting powder No. 8 or higher.
- Insert about 1 inch of the end into a moistened mix of 3 parts perlite to 1 part potting mix (3:1).
- Water the cuttings in lightly, so as not to wash off the applied rooting powder, but enough to settle the mix around cuttings.



***Wikstroemia uva*-ursi seedling – NTBG nursery—KLR**

- Keep them in a covered area and water every other day.
- They should root in about three to five months.
- Handle and care for your cuttings the same as described for the seedlings.

OUTPLANTING

- Your ʻākia will be ready for outplanting in six months to a year, when they have outgrown a 1–2-gallon pot.
- Choose a site similar to the wild habitat your ʻākia came from.
- They all need well-draining soil amended with cinder. Also, add a small amount of 8-8-8 NPK fertilizer to the soil.
- Water them in, and then water when it is dry until they are well established.
- ʻĀkia is an easy plant to take care of, and has few pest problems if it is planted properly.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your ʻākia; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Chickens can be pests because they eat the seeds from the pulpy fruits; they dig around the roots, exposing them, which dries them out. If you have chickens, be sure to collect the fruits before the chickens do.

U

URTICACEAE

(NETTLE FAMILY)

GENUS:
Boehmeria

HAWAIIAN NAME:
ʻĀkōlea

COMMON NAME:
False nettle

SPECIES	STATUS	HAWAIIAN RANGE
B. grandis	—	end (HI exc. Ni, Ka)

Shady

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds and cuttings



***Boehmeria grandis* flowers — DB**

GENERAL DESCRIPTION

In the wild, the shrubby ʻākōlea occurs in diverse mesic to wet forests, from wet streambeds to high atop valley ridges. They have thick, angular branches and ovate, opposite leaves about 8 inches long, with coarsely toothed edges. The leaves have a wrinkled appearance because of a fine network of veins. These plants are monoecious having both sexes of flowers (unisexual) on the same individual; the tiny flowers form along open branching spikes. These later develop into the tiny brownish achenes, dry, one-celled fruits, each containing one tiny seed. I have not had much experience propagating *Boehmeria* species, but think they can be grown easily from viable seeds or cuttings if they are cultivated in cool, moist climates, which mimic the higher elevations.

Entire Range: Hawaiian endemic

Wild Habitat: Grows along streambeds, on slopes, ridges, valleys, mesic valleys, and mesic to wet diverse mesic forests

Habit: Shrub

Mature Height: 1–2 m height

Stem/Trunk: Branches covered with fine hairs

Leaves: Leaves are simple, opposite, thick and leathery, oval and about 20 cm long by about 10 cm wide, with the upper surface wrinkled and covered with veins, hairs growing

between the veins, margins toothed, leaf tip pointed, leaf stalk about 5 cm long, stipules

Inflorescence/Flower: Flowers are unisexual and both male and female flowers occur on the same plant. The tiny flowers (clusters 2–4 mm in diameter) grow on open, branched panicles that are about 10 cm long; the male flowers are more abundant near the ends of each panicle.

Fruit: Fruits are achenes

Seed: One dry, small seed per fruit (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the dry fruits and keep them dry in a paper bag until they can be cleaned.
- Separate the seeds as directed for small dry seeds.
- Start the seeds fresh by soaking them in tap water for one hour.
- Surface sow them onto a dry mix of 3 parts perlite to 1 part potting mix (3:1), and then water them in.
- For optimal results keep the flat under an intermittent mist system.
- Or, keep them moist in a covered, shaded area protected from heavy rains.
- Begin foliar feeding, applying a light solution monthly after the seedlings sprout.

GERMINATION (initially slow-growing)

- Germination of all viable seeds will take about one to six months.
- Before transplanting, wait until four to six true leaves develop. This may take a month or so; be patient.
- Then transplant them into 2-inch pots; be very careful because the thin fibrous roots are easily damaged.
- Use a mix of 3 parts small black cinder to 1 part potting mix or 1 part peat moss (3:1), and water them in and keep them moist.
- Keep the seedlings in a shaded area.
- Repot them into larger pots in three to four months.
- Use a cindery well-draining mix with small amounts of 8-8-8 NPK fertilizer added to it.
- Move them into partial shade and continue to foliar feed them monthly.

CUTTINGS

- To propagate clonally by cuttings, first collect stems only from healthy vigorous growing plants. It is very important that the material never dries out or is exposed to direct sunlight.
- Follow the protocols for collecting semi-hardwood cuttings.
- Use rooting powder No. 1 or none at all. A stronger rooting powder will burn the cuttings.
- Insert at least one node of each cutting into a moistened mix of 3 parts perlite to 1 part potting mix (3:1), water them in lightly to settle the mix around the cuttings without washing off any rooting powder that may have been applied.
- Handle and care for them the same as for the seed flats and seedlings.

OUTPLANTING

- Your ʻākōlea will be ready to plant out in one year, when they have outgrown a 1–2-gallon pot.
- Choose a moist, shady site among other plants for added protection from strong winds.
- Use cinder to amend the soil for good drainage.
- Water them in, and then water when it is dry until your plants are well established.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your ʻākōlea; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants (p.40).

U

URTICACEAE

(NETTLE FAMILY)

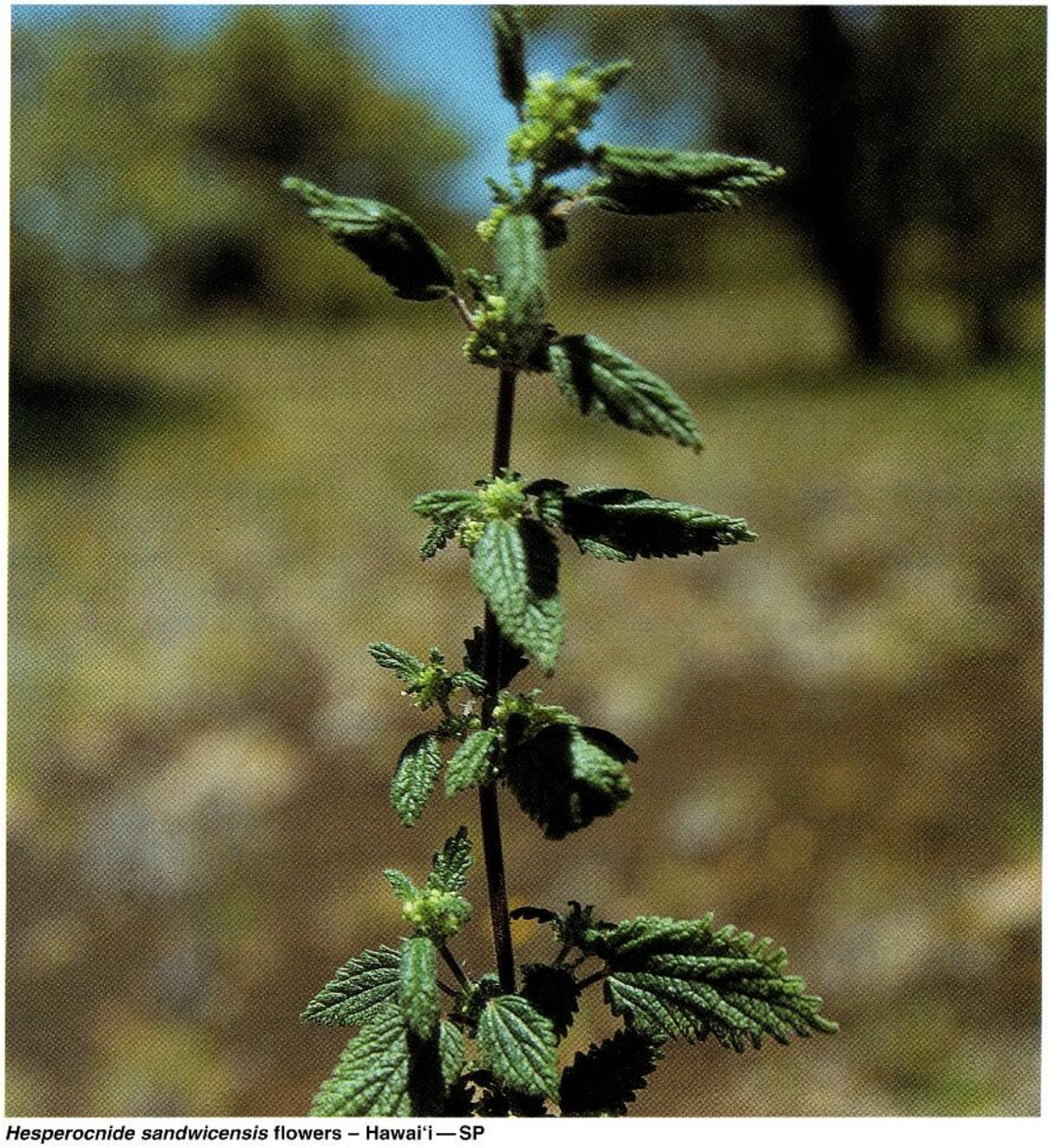
GENUS:	COMMON NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Hesperocnide	**Hawaiian nettle**	*H. sandwicensis*	R	end (H)

Full Sun

Range
Hawaiian Endemic

Description
herb

Propagation
seeds



***Hesperocnide sandwicensis* flowers – Hawai'i — SP**

GENERAL DESCRIPTION

The Hawaiian nettle is a branching, annual herb found in subalpine to alpine areas on Mauna Loa and Mauna Kea. The plants are covered with sharp, stiff, stinging hairs, especially when young. The thin, opposite leaves are less than 1 inch long and deeply toothed along the edges. Small clusters of inconspicuous flowers develop from the leaf axils. These ripen into the tiny oval-shaped achenes (dry fruits). Be careful when handling this plant, and watch out for the stinging hairs. Since they still have irritating substances that deter grazing herbivores, this may suggest that this genus is the result of a more recent colonization event to Hawai'i.

Also, be careful when you clean the seeds. When I was cleaning them in a colander, the irritating dry dust from the seeds made me sneeze until I left the area and got fresh air. The



H. sandwicensis (stinging hairs) – Maui—F&KS

seeds germinated readily at sea level but soon died. It is possible that they need to be grown in a dry, cold environment in the higher elevations to thrive, even though they are a weedy species.

Entire Range: Hawaiian endemic

Wild Habitat: Grows in subalpine woodlands or alpine areas

Habit: Upright, annual herb with watery sap and stinging hairs

Mature Height: 20–60 cm height

Stem/Trunk: Stems slender and covered with stinging hairs

Leaves: Leaves are opposite, thin, and 3- to 5-nerved, leaf margins coarsely toothed, oblong to lance-shaped about 5 cm long by about 2 cm wide, with stinging hairs; leaf stalks about 2 cm long; stipules

Inflorescence/Flower: Flowers are male or female, and both occur on the same plant; small (2–5 mm long), growing in dense, small clusters along stems in leaf axils, without bracts; flower parts in multiples of two or four

Fruit: Achenes, oval, compressed and enclosed by the calyx, about 1 mm long

Seed: Seeds are small and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate the nettle by seed, first collect the dry fruits and keep them dry in a paper bag until they can be cleaned.
- Separate the seeds as directed for small dry seeds.
- Start the seeds fresh by soaking them in tap water for one hour.
- Surface sow them onto a dry mix of 3 parts perlite or 3 parts fine black cinder to 1 part potting mix (3:1), and then water them in.
- Water every other day keeping on the dry side, but do not let the mix dry out completely.

GERMINATION

- Germination of all viable seeds will take about one to six months.
- Before transplanting, wait until four to six true leaves develop; this may take a few months so be patient.
- Then transplant them into 2-inch pots; be very careful because the thin fibrous roots are easily damaged.
- Use a mix of 3 parts small black cinder to 1 part potting mix (3:1), and water them in.
- Keep the seedlings in an area protected from strong wind and rain.
- Repot them into larger pots in three to four months.
- Use a cindery well-draining mix with small amounts of 8-8-8 NPK fertilizer added to it.
- Move them into full sun to help harden them off for outplanting.

CUTTINGS

- These annuals are short-lived, so it is best to grow them from seed.

OUTPLANTING

- Your *Hesperocnide* will be ready to plant out in four to six months, when they have outgrown a 6-inch or 1-gallon pot.
- Choose a site with full sun and with well-draining soil amended with cinder and small amounts of 8-8-8 NPK fertilizer mixed into the soil.
- Water them in, and then water when they are dry for about one month. They do best in a cool, dry location.
- These are weedy plants, and will readily regenerate on their own.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your Hawaiian nettle; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants (p.40).

URTICACEAE

(NETTLE FAMILY)

GENUS:

Neraudia

HAWAIIAN NAMES:

Ma'aloa; ma'oloa; 'oloa

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
N. angulate var. *angulate*	E	end (O) diverse mesic forests
N. angulata var. *dentate*	E	end (O)
N. kauaiensis	R	end (K) diverse mesic forests
N. melastomifolia	—	end (K, O, Mo, M) diverse mesic forests
N. ovata	E	end (H) dry and subalpine forests
N. sericea	E	end (Mo, L, M, Ka) dry to mesic forests

Partial Sun

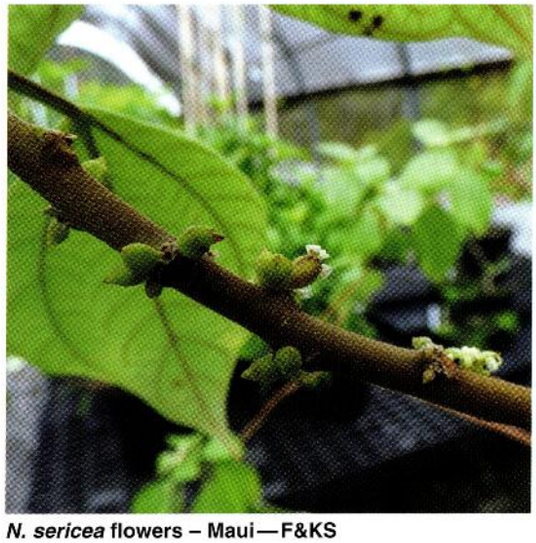
Range
Hawaiian Endemic

Description
sprawling shrub to small tree

Propagation
seeds and cuttings



N. sericea **– Maui—F&KS**



N. sericea **flowers – Maui—F&KS**

GENERAL DESCRIPTION

Neraudia occur in dry to subalpine areas as small, upright trees to sprawling shrubs that are covered with tiny silky hairs. The thin, alternate leaves which are covered with tiny white hairs, are oval and dark green on the upper surface and gray-green on the lower surface. The miniature flowers are unisexual (male or female) and develop in tight clusters at the leaf axils. The female flowers mature into pulpy achenes (fruits), which contain tiny egg-shaped seeds. I have had more success propagating this genus from cuttings than from seeds. This may be due to the dioecious nature of the plants, which need both male and female plants in a population to produce viable seeds. The strong bark of the ma'aloa (*N. melastomifolia*) was once used by Hawaiians to make a dark, coarse, durable kapa (Abbott 1992).

Entire Range: Hawaiian endemic

Wild Habitat: Dry, mesic to diverse mesic forests

Habit: Sprawling shrubs, upright shrubs to small trees

Mature Height: 1–6 m height

Stem/Trunk: Branches have watery-milky to milky sap and are covered with white or gray hairs

Leaves: Depending on the species, the alternate leaves are thin and membranous to leathery; oval, elliptical to lance-shaped, leaf margins entire to toothed, definitive palmate 3-nerved veins, upper and lower surface vary from smooth to covered with fine hairs, leaf stalks present; stipules

Inflorescence/Flower: The small flowers (and plants) are male or female (dioecious); they grow as clusters in the leaf axils, the female flowers have no flower stalks, the male

flowers have either no flower stalks or very minute flower stalks; the flower parts are covered with fine hairs

Fruit: Fruit is an achene, 1–3 mm long, encased in the calyx

Seed: Seeds are tiny, dry, and oval to elliptic (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seeds, collect the small slightly pulpy fruits, and keep them moist until cleaned.
- Remove the pulp as directed for small pulpy seeds.
- Soak them in tap water for one hour. If the seeds float, it may be because they are nonviable.
- Surface sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), and water them in.
- Begin foliar feeding applying a light solution monthly after the seedlings sprout.

GERMINATION

- Germination of all viable seeds will take about one to six months.
- Before transplanting, wait until four to six true leaves develop; this may take a month or more so be patient.
- Then transplant them into 2-4-inch pots; be very careful not to disturb the thin fibrous roots as they are easily damaged.
- Use a mix of 3 parts small black cinder to 1 part potting mix (3:1), and water them in.
- Keep the seedlings in a shaded area, protected from heavy rains and wind.
- Repot them into larger pots in three to four months.
- Use a cindery well-draining mix with small amounts of 8-8-8 NPK fertilizer added to it.
- Move them into partial shade and continue to foliar feed them monthly.

CUTTINGS

- To clonally propagate by cuttings, first collect semi-hardwood tip cuttings from the top of the plant.
- Remove the lower leaves and keep the cuttings moist in a sealed plastic bag until you start them.
- Cut each stem into 5-inch pieces and cut the top foliage in half; apply rooting powder No. 1 to the recut stem bottoms.
- Insert at least one node into a moistened mix of 3 parts perlite to 1 part potting mix (3:1) and then water them in lightly, so as not to wash off the rooting powders.
- Keep the cuttings in an intermittent mist system to obtain the best results.
- They should be rooted in one to three months.
- Transplant the rooted cuttings into 4-6-inch pots with well-draining cindery mix.
- Keep them moist in a shaded, covered area or under a mist system.
- They grow fast and will need to be repotted in two to four months.

OUTPLANTING (during the rainy season is best)

- Your plants will be ready to plant out in about one year, when they have outgrown a 1-gallon pot.
- Choose a site with partial shade and with well-draining soil amended with cinder.
- Plant them with other plants, trees, ferns, and shrubs for added protection.
- Foliar feed them monthly and work into the soil a small amount of 8-8-8 NPK fertilizer every three to six months, depending on the rainfall.
- Water them when it is dry until they are well established; monitor them closely for pests or poor drainage.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Neraudia*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly, water the plants first to reduce any stress.

U

URTICACEAE

(NETTLE FAMILY)

GENUS:

Pilea

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. peploides	—	ind (Le, HI: exc. Ni, Ka) mesic to wet forests

Partial Sun

Range
Indigenous

Description
perennial herb

Propagation
seeds and cuttings

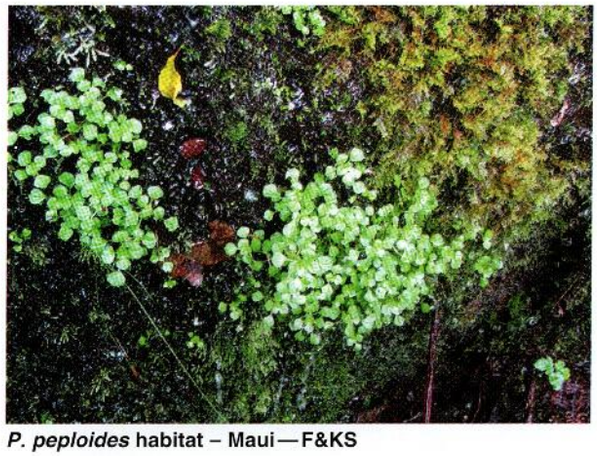


***Pilea peploides*—JO**

GENERAL DESCRIPTION

Pilea is a short-lived perennial herb, with small fleshy stems and leaves, found growing in moist, damp areas throughout S. America to Hawai'i. This low-growing, succulent creeper is related to introduced fast-growing cousins such as "Artillery plant" and "Creeping Charley".

Entire Range: Indigenous to northern South America, Galapagos Islands, and Hawai'i, all of the main islands except Ni'ihau and Kaho'olawe.



***P. peploides* habitat – Maui—F&KS**

Wild Habitat: Mesic sites, stream beds, waterfalls, moist cliffs, and seeps in mesic, diverse mesic to wet forests

Habit: Slender, low short-lived perennial

Mature Height: 5–20 cm long

Stem/Trunk: Fleshy stems, weakly ascending or low-growing

Leaves: Leaves opposite, openly spaced, becoming denser near tips; upper leaf surfaces green, lower surfaces pale with red tinge, leaves 3-nerved, leaf margins with rounded teeth, leaf stalks 3–25 mm long; Stipules

Inflorescence/Flower: Flowers small, male or female, and the plant is monoecious; growing in dense, clusters in the leaf axils without flower stalks

Fruit: Fruit is an achene

Seed: Seeds are small, dry, and hard (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate *Pilea* by seeds, first collect the small whitish, pulpy fruits when soft and mature and keep them moist in a plastic bag until cleaned.
- Separate the tiny seeds from the pulp as directed for small pulpy seeds.
- Start the seeds fresh; no pretreatments are needed.
- Surface sow the seeds onto a mix of 3 parts black cinder to 1 part potting mix or 1 part peat moss (3:1) and then water them in.
- Keep them in a shaded, covered area, keeping them moist; they grow in areas near water.

GERMINATION

- All viable seeds from the *Pilea* will germinate in one to four months.
- Wait until four to six true leaves emerge, then carefully transplant them into 2-inch pots; be careful to avoid damaging the fine fibrous roots.
- Use a cindery mix of 1 black cinder to 1 peat moss (1:1) for best results, and add in a small amount of 8-8-8 NPK fertilizer.
- Repot into a larger pot in four to six months, and move into partial shade.

CUTTINGS

- To clonally propagate by cuttings, take herbaceous tip cuttings and follow the protocols described for herbaceous tip cuttings (pg.22).

OUTPLANTING (during the rainy season is best)

- Your plants will be ready to plant out in 6 months, when they have outgrown a 4- or 6-inch pot.
- Choose a site with full to partial shade and with moist, draining soil.
- Plant your *Pilea* with other plants, trees, ferns, and shrubs for added protection, allowing each plant room to grow.
- Water them when it is dry until they are well established; monitor them closely for pests or poor drainage.

PESTS

- Slugs love to feed on low-growing herbaceous plants, and may eat the leaves and the fruit; if you discover them, apply slug bait or pick them off by hand.

URTICACEAE

(NETTLE FAMILY)

GENUS:

Pipturus

HAWAIIAN NAMES:

Māmaki; māmake; waimea

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
P. albidus	—	end (HI exc. Ni, Ka) mesic to wet forests
P. forbesii	—	end (M) wet forests and sub-alpine, higher elevations
P. kauaiensis	—	end (K) diverse mesic forests
P. ruber	—	end (K) diverse mesic to wet forests

Partial Sun

Range
Hawaiian Endemic

Description
shrub to tree

Propagation
seeds and cuttings



***Pipturus ruber*—DR**

GENERAL DESCRIPTION

Māmaki is a small tree up to 20 feet tall or a spreading shrub with watery sap and miniscule hairs along the branches. It has papery thin, alternate leaves that are tough and flexible. The flowers form in tight clusters at the leaf axils and have either male or female flower parts (unisexual), and both are found on the same plant (they sometimes occur as one sex per plant). The fruits are mulberry-like; the pulpy receptacles have many tiny brown seeds embedded throughout them. This genus was dispersed in the islands by birds, and it is said that the four endemic species are the result of a single colonizer (Wagner 1990). The Hawaiians made a coarse brown kapa and cordage from the fibrous bark; the whitish, pulpy fruits were eaten and used as a laxative, and the leaves were made into a tonic tea (Abbott 1992). The leaves of the māmaki are food for caterpillars of the native Kamehameha butterfly (*Vanessa tameamea*). In this family, the valuable māmaki is by far the easiest to grow from seeds and cuttings. This robust plant is also easy to maintain in the landscape if it is grown with the proper moisture and shade.

Entire Range: Hawaiian endemic

Wild Habitat: Mesic, diverse mesic to wet forests; subalpine to alpine regions

Habit: Shrubs to small trees

Mature Height: 1.5–6 m height

Stem/Trunk: Branches with watery sap and covered with fine or straight hairs

Leaves: Leaves are alternate, thin and papery to thicker and leathery, palmately veined, 3- to 5-nerved, veins are reddish and have concentrations of calcium carbonate along them which are visible on the upper surfaces; stipules

Inflorescence/Flower: Flowers are unisexual and occur in various combinations on different species; the minute flowers grow as clusters either sessile or in influences in the leaf axils

Fruit: The fruit has a pale-white, fleshy receptacle with the tiny achenes embedded in it

Seed: Small, dry seeds (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS



***Pipturus ruber* fruits — DR**

- To propagate by seeds, first collect the whitish, pulpy fruits when soft and mature and keep them moist in a plastic bag until cleaned.
- Separate the tiny seeds from the pulp as directed for small pulpy seeds.
- Start the seeds fresh; no pretreatments are needed.
- Surface sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1), and water them in.
- Keep them in a shaded, covered area and water them every other day.
- Once the seedlings sprout, begin foliar feeding them monthly, using a light solution.

GERMINATION (high rate)

- All viable seeds from your māmaki will germinate in one to four months.
- Wait until four to six true leaves emerge, then carefully transplant them into 2-inch pots; be careful to avoid damaging the fine fibrous roots.
- Use a cindery mix for best results, and add in a small amount of 8-8-8 NPK fertilizer.
- Repot in two to four months, and move into partial shade.

CUTTINGS

- To clonally propagate by cuttings, first collect semi-hardwood tip cuttings from the top of the plant.
- Remove the lower leaves and keep the tips moist in a sealed plastic bag until you start them.
- Cut each stem into 5-inch pieces and cut the top foliage in half; apply rooting powder No. 1 to the recut stem bottoms.
- Insert at least one node into a moistened mix of 3 parts perlite to 1 part potting mix (3:1) and then water them in lightly, so as not to wash off the rooting powder.
- Keep the cuttings in an intermittent mist system to obtain the best results or in a shaded, covered area.
- They should be rooted in one to three months.
- Transplant the rooted cuttings into 3- to 4-inch pots with well-draining cindery mix.
- Keep the potted cutting moist in a shaded area, protected from drying winds.
- They grow fast and will need to be repotted in two to four months.

OUTPLANTING

- Your māmaki will be ready to plant out in about six months to one year, when they have outgrown a 1-gallon pot.
- Choose a site out of strong winds in partial shade with well-draining soil.
- Plant them with other plants, trees, and shrubs for added protection.
- Foliar feed them monthly and work a small amount of 8-8-8 NPK fertilizer into the soil every three to six months, depending on the rainfall and the health of the soil.
- Water them when it is dry until they are well established; monitor them closely for pests or poor drainage.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your māmaki. These sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- I have several māmaki in my yard at 300 feet elevation; they have not had any major pest problems.

URTICACEAE

(NETTLE FAMILY)

GENUS:	HAWAIIAN NAME:	SPECIES	STATUS	HAWAIIAN RANGE
Touchardia	Olonā	*T. latifolia*	—	end (HI exc. Ni, Ka)



***Touchardia latifolia* flowers — DR**

Shady

Range
Hawaiian Endemic

Description
sprawling shrub or small tree

Propagation
seeds and cuttings

GENERAL DESCRIPTION

Olonā is uncommon (over harvested) and occurs in mesic to wet forests, generally in moist valleys. It grows as a sprawling shrub or small tree 3–10 feet tall. The young growth is covered with coarse hairs; the older growth is smooth. The coarse, papery, leaves are large and alternate with red veins, and are variable when it comes to leaf size, depending on habitats. The small, unisexual flowers form clusters near the tops of the branches and at the leaf axils. These later ripen into orangish, mulberry-like, fleshy receptacles embedded with tiny tan seeds. The early Hawaiians had many uses for the durable and valuable fibrous bark, such as: fine cords, ropes, fishing nets, and the framework for feather caps and helmets (Abbott 1992). Olonā is fairly easy to grow and maintain in a moist, shady landscape. Its seeds germinate readily but the seedlings do not tolerate transplantation well; the fibrous roots are fragile and easily damaged. I recommend starting the seeds in individual peat pots to avoid transplant shock.

Entire Range: A monotypic genus endemic to the Hawaiian archipelago

Wild Habitat: Mesic valleys and wet forests

Habit: Shrub, upright to sprawling, with viscid sap

Mature Height: 1–3 m height

Stem/Trunk: Few branches; young branches covered with fine hairs, becoming smooth as they mature

Leaves: Leaves are alternate, palmate, 3-nerved; reddish veins, margins with rounded teeth; the large leaves are dark green and papery; they are oval to lance-shaped, becoming pointed at the tip; they are about 50 cm long by 18 cm wide; the upper surface smooth, the lower surface smooth to hairy, especially along the veins; leaf stalks about 1–20 cm long; stipules

Inflorescence/Flower: The flowers are unisexual and both male and female flowers grow on the same plant; they are minute, growing in branching cymes, dense, clustered in the leaf axils; the flower parts are in multiples of five; The flower stalks are short

Fruit: The oval beaked achene fruits are tiny and enclosed by the fleshy orange calyx

Seed: The seeds are tiny and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits when they are ripe, soft, and orangish; keep them moist in a plastic bag until they are cleaned.
- Separate the pulp from the tiny seeds as directed for small pulpy seeds.
- Start the seeds fresh for best results; no pretreatments are necessary.
- Surface sow them in individual peat pots kept in a community flat, and water them in.
- Or, sow onto a mix of 3 parts perlite to 1 part potting mix (3:1). Remember, when transplanting them, do not disturb the roots at all.
- Keep the flat in a moist, shaded, covered area in or near a mist system, or water them every day.

GERMINATION

- All viable olonā seeds will germinate in three weeks to five months.
- Foliar feed the sprouted seedlings monthly, applying a light solution.
- If you started your seeds in peat pots, leave them there to continue to grow; transplant the entire peat pot into 4-inch pots with cindery mix when the seedlings are twice as tall as the peat pots.
- With community flats, wait until six true leaves develop before transplanting into 2–3-inch pots.
- Use a well-draining, cindery mix, adding in a small amount of 8-8-8 NPK fertilizer.
- Keep the seedlings in a moist, shaded area.

CUTTINGS

- To propagate olonā by cuttings, first collect softwood to semi-hardwood tip cuttings from the top of the plant.
- It is best to collect cutting material in the spring on moist, rainy days.
- Remove the lower leaves and keep them moist in a sealed plastic bag; start them as soon as possible, same day is best.
- Cut each stem into 5-inch pieces and reduce the top foliage by half; apply rooting powder No. 1 to the recut stem bottoms.
- Insert at least one node into a moistened mix of 3 parts perlite to 1 part potting mix (3:1) and then water them in lightly so as not to wash off the rooting powders.
- Keep the cuttings in an intermittent mist system to obtain the best results.
- They should be rooted in one to three months.
- Transplant the rooted cuttings into 3- to 4-inch pots with well-draining cindery mix.
- Keep them moist in a shaded, covered area or under a mist system.

OUTPLANTING (during the rainy season is best)

- Your olonā will be ready to plant out in about one year, when they have outgrown a 1-gallon pot.
- Choose a site that is moist, shady, and protected from strong, direct winds.
- Plant them with other trees and/or shrubs for added protection.
- Foliar feed them monthly and work a small amount of 8-8-8 NPK fertilizer into the soil every three to six months, depending on soil health and rainfall.
- Water them when it is dry until they are well established; monitor them closely for pests, soil moisture, or poor drainage.

PESTS

- Slugs may eat the leaves and the fruit; if you discover them, apply slug bait or pick them off by hand.
- Red spider mites attack the undersides of leaves. To remove them, spray weekly with horticultural oil; water the plants first to reduce any stress.

U

URTICACEAE

(NETTLE FAMILY)

GENUS:

Urera

HAWAIIAN NAME:

Ōpuhe; hōpue; hona

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
U. glabra	—	end (HI exc. Ni, Ka) mesic to wet forests
U. kaalae	E	end (O) diverse mesic forests

Partial Sun

Range
Hawaiian Endemic

Description
shrub and tree

Propagation
seeds and cuttings



***Urera kaalae* flowers – O'ahu — SP**

GENERAL DESCRIPTION

Urera is generally found in the wetter gulches, gullies, and on misty slopes. It grows as shrubs to small trees with brown drooping branches. The thin, papery, coarse leaves are alternate, dark to pale-green with red veins. The unisexual flowers have either male or female parts and both sexes can occur on the same plant or each on different individuals. They develop in tight forked clusters at the top of the branches from the leaf axils. The orangish-yellow fleshy fruits contain small tan seeds. The fibrous inner bark was occasionally used by the Hawaiians to make cord and rope for fishnets but was not considered as durable as olonā (Neal 1965).

Entire Range: Hawaiian endemic

Wild Habitat: Occurs on slopes and gulch bottoms, in mesic, wet to diverse mesic forests

Habit: Shrubs or small trees with watery sap, with stinging hairs (*U. glabra*) on young plant parts

Mature Height: 2–8 m height

Stem/Trunk: Ōpuhe stems have many branches, are smooth, drooping, weak, hollow, spreading, and have pale-brown bark; *U. kaalae* produces copious amounts of sap which becomes greenish black when it is exposed to air

Leaves: The leaves are thin, papery, alternate, and palmately red-veined with three to five nerves; the leaf margins are entire or they may have rounded teeth. The leaf shape is variable according to species: *U. glabra* leaves are triangular to roundish-elliptic to lance-shaped about 25 cm long by about 9 cm wide; *U. kaalae* leaves are heart-shaped and about 18 cm long by about 10 cm wide. Leaf upper surfaces are smooth and dark to pale-green,

the under surface of the leaves of *U. glabra* have short hairs that may be denser along the veins. Leaf stalks are up to about 14 cm long.

Inflorescence/Flower: The minute flowers are unisexual and the plants are usually dioecious (each plant is either male or female, but sometimes a plant will have both male and female flowers on it); the flowers grow in clustered cymes, in the leaf axils or from older nodes

Fruit: The fleshy, enlarged orange-yellow calyx encloses the small, compressed achene fruits

Seed: Seeds are small and dry (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the fruits and keep them moist in a plastic bag until they can be cleaned.
- Separate the seeds as directed for small pulpy seeds.
- Start the seeds fresh; no pretreatments necessary.
- Surface sow them onto a dry mix of 3 parts perlite or 3 parts black cinder to 1 part potting mix (3:1), and then water them in.
- For optimal results keep the seed flat under an intermittent mist system.
- Or, keep them moist in a covered, shaded area protected from heavy rains and drying winds.
- Begin foliar feeding applying a light solution, monthly after the seedlings sprout.

GERMINATION (slow-growing at first)

- Germination of all viable seeds will take about one to six months.
- Before transplanting, wait until four to six true leaves develop; this may take a month or more so be patient.
- Then transplant them into 2-inch pots; be very careful because the thin fibrous roots are easily damaged.
- Use a mix of 3 parts small black cinder to 1 part potting mix or 1 peat moss (3:1), and water them in and keep them moist.
- Keep the newly potted seedlings in a shaded area.
- Repot them into larger pots in three to four months.
- Use a cindery well-draining mix with small amounts of 8-8-8 NPK fertilizer added to it.
- Move them into partial shade and continue to foliar feed them monthly.



***Urera glabra* flowers & fruit – Moloka'i — KRW**

CUTTINGS

- To propagate by cuttings, first collect stems only from healthy, vigorous growing plants. It is very important that the material never dries out or is exposed to direct sunlight.
- Follow the protocols for collecting semi-hardwood cuttings.
- Use rooting powder No. 1 or none at all; a stronger rooting powder will burn the cuttings.
- Insert at least one of the bottom nodes of each cutting into a moistened mix of 3 parts perlite to 1 part potting mix (3:1); water them in lightly to settle the mix around the cuttings without washing off any rooting powder that may have been applied.
- Handle and care for them the same as for the seed flats and seedlings.

OUTPLANTING

- Your ōpuhe will be ready to plant out in one year when they have outgrown a 1- or 2-gallon pot.
- Choose a moist, shady site among other plants for added protection from strong winds.
- Use cinder to amend the soil for good drainage.
- Water them in, and then water when it is dry until your plants are well established.

PESTS

- Ants and their associated pests (scale, mealybugs, thrips, and aphids) can infest your ōpuhe; bait for the ants according to the protocols for ants.
- Use a systemic pesticide or spray with a horticulture oil to control them.

V

VERBENACEAE

(VERBENA FAMILY)

GENUS:
Vitex

COMMON NAME:
Beach vitex

HAWAIIAN NAMES:
Pōhinahina; pōlinalina; kolokolo kahakai

SPECIES	STATUS	HAWAIIAN RANGE
V. rotundifolia	—	ind (HI exc. Ka)

Full Sun

Range
Indigenous

Description
low branching shrub

Propagation
seeds and cuttings



***V. rotundifolia* flowers – Maui—F&KS**

GENERAL DESCRIPTION

The hardy and attractive beach vitex occurs in the wild on sandy beaches. It grows as a low, trailing shrub with long, wide-spreading main stems that trail above or in the ground (sand) and roots readily at the nodes. The rounded gray-green leaves are opposite and silvery white on the underside, with many miniscule hairs that reflect the harsh sun and salt spray. Small clusters of purplish flowers develop at the branch tips. These ripen into the small, round, green fruit that blackens with maturity. The fruits have a corky layer typical of coastal plants. Pōhinahina make great coastal ground covers holding the dirt or sand in place with minimal maintenance. I have some in my yard, which is somewhat rainy at 300 feet elevation; the plants are doing great. They are planted in well-draining soil and only get partial sun. *Vitex* can handle heavy pruning; you can easily root the clippings instead of throwing them away.

Entire Range: Indigenous to China, Taiwan, Japan south to Malaysia, India, Sri Lanka, Mauritius, Australia, Pacific Islands, and Hawai'i: all of the main islands except Kaho'olawe

Wild Habitat: Strand plant, sandy beaches, rocky shores, and dunes

Habit: Low branching shrub

Mature Height: 1–3 dm height

Stem/Trunk: The stems root at the nodes, trail on the ground, form mats; side branches grow upright, and the branches are square in cross section

Leaves: Leaves are simple, opposite, compound with two to three leaflets, each leaflet roundish, the upper surface pale green, covered with a dense layer of fine hairs; lower leaf surface grayish-green; leaflet margins entire, leaf stalks about 1 cm long; the leaves have a sage-like odor and are aromatic when crushed

Inflorescence/Flower: Flowers are perfect, in short dense cymes, with minute bracts, bell-shaped calyx, blue-violet corolla, shaped like a funnel or trumpet and bilaterally symmetrical, with four smaller petals fused together until they reach the open end, and a bottom "lip" that is a bigger petal; five petals, four stamens in two pairs, extending beyond the flower opening; style extended beyond flower petals

Fruit: Fruit is a round drupe with a hard endocarp (layer surrounding the seed coat); green ripening to a dark bluish-black when ripe, about 6 mm in diameter

Seed: Seeds lack endosperm, and are roundish to oblong (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the round, blackish fruit and keep them moist in a plastic bag until they are cleaned.
- Remove the thin, dark coat by massaging them against a wire strainer wall.
- Start the seeds fresh for higher germination rates.
- To pretreat the seeds, soak them in hand-hot or tap water for twenty-four hours. **Note**: the viable seeds are corky and tend to float.
- Sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) then cover the seeds with an additional ½ inch of mix, and water them in.
- Keep them in a covered area, and water them every other day.
- Once the seedlings sprout, water them only when they are dry, but do not allow them to dry out completely.

GERMINATION

- All of the viable pōhinahina seeds will germinate in one to six months; germination is staggered, so wait a while before tossing out your seedling tray.
- These seedlings are slow-growing; wait until four true leaves form before transplanting them into 2-inch pots.
- Use a well-draining mix amended with 2 parts perlite or 2 parts fine black cinder to 1 part potting mix (2:1).
- Keep them in the shade for two weeks, and then move them into full sun.
- Repot into larger pots every two to three months; the growth rate speeds up with age.

CUTTINGS (faster than seeds)

- To propagate clonally by cuttings, collect semi-hardwood cuttings that are 4–5-inches long from the main stems that root at the nodes along the ground.
- Remove and discard all of the thinner branches and leaves; keep them moist in a sealed plastic bag.
- Insert the recut bottom end of each stem into rooting powders No. 1 or 3, then into moistened mix made up of 3 parts perlite to 1 part vermiculite (3:1), lightly water the cuttings in, and be careful not to wash off the rooting powders.
- Keep them in a covered area, watering every other day.
- They should form roots in two to four months.
- When they are rooted, transplant them into 4-inch pots.
- Follow the handling and care directions given for the seedlings.

OUTPLANTING

- Your pōhinahina will be ready to plant out in six months to a year, when it has outgrown a 6-inch to 1-gallon pot.
- Choose a site with full sun and sandy or well-draining soil, amended as directed.
- Allow lots of room for the plant to spread out.
- Plant your pōhinahina with other shrubs such as ʻaʻaliʻi, and trees like wiliwili or naio.
- Water them in initially and then only water during prolonged periods of drought.

PESTS

- Spittle bugs may infest your plants. If they do, wash them off by hand, or spray them with rubbing alcohol.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Vitex*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.

V

VIOLACEAE
(VIOLET FAMILY)

GENUS:
Isodendrion

HAWAIIAN NAME:
Aupaka; wahine noho kula

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
I. hosakae	E	end (H) dry shrubland
I. laurifolium	E	end (K, O) diverse mesic forests
I. longifolium	V	end (K, O) diverse mesic forests
I. pyrifolium	Ex	end (HI exc, K, Ka) dry low elevations

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
shrub

Propagation
seeds



***Isodendrion laurifolium* flowers — JO**

GENERAL DESCRIPTION

Aupuka are slender, straight, erect woody shrubs with few branches. They have narrow, alternate leaves that cluster toward the ends of the thin, fragile branches. The tubular-shaped purple to greenish-yellow perfect flowers (male and female parts on the same flower) also form toward the branch ends. These ripen into dry, papery capsules that contain small, round, greenish to tan seeds. *Isodendrion* is threatened in the wild from low-forest destruction caused by agriculture, introduced animals (herbivores), and aggressive, introduced, domineering plants. In cultivation I have found this genus to be weedy, with self-pollinating flowers producing viable seeds within a year. If the seeds fall to the ground, they will germinate readily.

Entire Range: *Isodendrion* is endemic to the Hawaiian Archipelago

Wild Habitat: Occurs in dry shrubland, diverse mesic to wet forests, and on steep slopes and cliffs

Habit: Slender, branching (few) shrubs

Mature Height: 3–20 dm height

Stem/Trunk: Branches are wand-like, covered with fine hairs (some species only the young branches), with ascending branches

Leaves: Leaves are crowded near branch ends, papery to somewhat leathery, narrow lance-

shaped or more oblong with toothed or rounded toothed margins, or margins entire, short leaf stalks; stipules

Inflorescence/Flower: Flowers are fragrant, perfect, grow from the leaf axils, are solitary, have short flower stalks, five sepals, five fused petals, greenish, yellow to purple, all petals are "clawed," and overlapping forming a corolla tube; and five stamens

Fruit: Fruit is an oval-shaped three-lobed capsule with conspicuous venation, and three valves

Seed: Seeds are roundish, hard, shiny, with a ridge, and endosperm is present (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the capsules when they are dry and tan and keep them dry in a paper bag.
- Remove the seeds manually by opening up the capsules.
- Start the seeds fresh for best germination rates; no pretreatments are needed.
- Surface sow them onto a mix of 3 parts perlite to 1 part potting mix (3:1), then water them in.
- Keep them in a covered area, watering every other day.
- Foliar feed them monthly with a light solution once the seedlings sprout.



***Isodendrion hosakae* – flower & fruit — SB**

GERMINATION

- Germination of all viable seeds will take one to six months.
- Wait until four to six true leaves develop, then transplant them into 2-inch pots; more seeds will continue to sprout so keep the flat intact.
- Use a well-draining cindery mix and add small amount of 8-8-8 NPK fertilizer.
- Keep them in a shaded area for two to three weeks, then move them into partial sun to help harden them off and prepare them for outplanting, continue to foliar feed monthly.

OUTPLANTING

- Your plants will be ready to plant out in about six months to a year, when they have outgrown a 1–2-gallon pots.
- Choose a site with well-draining soil in partial to full sun and protected from the direct wind; plant them with other plants, such as ferns, shrubs, and trees.
- Amend the soil with cinder and add a small amount of 8-8-8 NPK fertilizer.
- Water them in, then water when they are dry until they are well established. Monitor them closely for poor soil drainage, and watch to see of the plants have been planted too deep, as the stems will rot.

PESTS

- The black twig borer bores holes in the thin stems; this kills the branches and gives the plant a ragged appearance. If this occurs, trim off the dead branches and treat your plant with a systemic pesticide.
- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Isodendrion*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Red spider mites attack the undersides of leaves. To remove them, spray with horticultural oil weekly; water the plants first to reduce any stress.

V

VIOLACEAE
(VIOLET FAMILY)

Sun Requirements
Species specific

Range
Hawaiian Endemic

Description
small perennial herb to shrub

Propagation
seeds and cuttings

1: Sun requirements differ for each species.

GENUS:
Viola

HAWAIIAN NAME:
Pāmakani; ʻolopū

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
Viola chamissoniana	E	mesic to wet forests
ssp. *chamissoniana*		end (O)
ssp. *robusta*		end (Mo)
ssp. *tracheliifolia*		end (K, O, Mo, M)

HAWAIIAN NAME:
—

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
V. helenae	E	end (K) along streams

HAWAIIAN NAMES:
Nani Waiʻaleʻale; kalili; liliwai

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
V. kauaiensis	E	wet forest, open bogs
var. *kauaiensis*	—	end (K, O)
var. *wahiawaensis*	—	end (K)

HAWAIIAN NAME:
—

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
V. lanaiensis	E	end (L, M) ridges and slopes
V. maviensis	—	end (Mo, M, H) open bogs
V. oahuensis	E	end (O) wet forests
V. wailenalenae	—	end (K) wet forests



Viola maviensis **flowering – Maui — JO**

GENERAL DESCRIPTION

Hawaiian endemic violets occur as small, perennial herbs to slender, woody shrubs up to 30 inches tall. Some have low trailing underground stems that root (rhizomes). It is believed that all of these are derived from a single common colonizer from South America (Wagner 1990). The alternate, heart-shaped leaves tend to cluster at the branch ends, as do the purple to whitish fragrant flowers that rise above the foliage on long stems and are pollinated when they open. The dry capsules are thin and papery, containing many small, round, dark seeds. The seeds germinate fairly easily but the plants prefer to grow in cool, moist places with wet feet (boggy), whereas *V. chamissoniana* and *V. lanaiensis* will tolerate hot, dry locations if planted in well-draining soil. They can also be propagated by rhizome-stem cuttings. Keep these moist at all times until they are rooted.

Entire Range: Hawaiian endemic

Wild Habitat: Occur in open bogs, on ridges and slopes, along streams, within mesic to wet forests

Habit: Small perennial herbs to branching woody shrubs; some with rhizomes and the stem growing below the ground; some are terrestrial or epiphytic

Mature Height: 1–8 dm height

Stem/Trunk: Stems are herbaceous to woody, and can grow upright to downward, unbranched to branched; some plants have rhizomes

Leaves: Leaves are alternate, strongly heart-shaped to less so; with toothed margins slight or rounded, leaf stalks shorter than leaf blade or equal or longer than the leaf blade; leaves may be clustered toward branch ends or spaced openly along the stems; thin stipules

Inflorescence/Flower: Flowers are perfect, axillary, with five sepals, five petals, and have a bilaterally symmetrical blossom, the lower petal distinctly wider than the other petals; of various combinations of white-tinged with purple, pale lavender or white, greenish, or pale yellow; pollinated when the flower is open

Fruit: Fruit is a dry capsule, thin and papery, which opens (dehisces) along each chamber or cell

Seed: Seeds are numerous, dark, small, roundish, with a leathery seed coat, and dull (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the dry thin capsules when they are mature and starting to open.
- Keep them dry in a paper bag until they are separated; you can do this manually by breaking the capsules open.



***Viola oahuensis* flowers – O'ahu — SP**

- Start the seeds fresh for higher germination rates.
- Pretreat the seeds by soaking them in tap water for one to three hours; the viable seeds will sink.
- Surface sow the seeds onto a mix of 3 parts perlite to 1 part potting mix (3:1) for *V. chamissoniana* and *V. lanaiensis*; water them in.
- Surface sow the seeds of the remaining species onto a mix of 3 parts fine cinder to 1 part peat moss (3:1) and keep them in an intermittent mist system that is on only during daylight hours.
- Keep the flat in a covered, shaded area, and water them every other day.

GERMINATION (slow-growing)

- All viable seeds from your violets will germinate in one to four months.
- Foliar feed the seedlings monthly with light fertilizer solutions to help strengthen their growth.
- Wait until four to six true leaves develop in a few months, and then transplant them into 2-inch pots.
- Use a well-draining mix amended with cinder.
- Keep them in a shaded area protected from direct sunlight and heavy rain, as they are delicate seedlings.
- Repot them in three to four months into a shallow, wider pot, because they are shallow-rooted plants.
- Move them into an area with partial shade to full sun for *V. chamissoniana* and *V. lanaiensis*.

CUTTINGS (rhizome)

- To clonally propagate your violets by cuttings from the rhizomes, first collect the rhizome-like stems; treat them like a cutting; there should be some roots present.
- Remove any lower foliage and keep them out of direct sunlight in a sealed plastic bag.
- Insert each cutting into a mix made of 3 parts perlite to 1 part potting mix (3:1) or 3 parts cinder to 1 part peat moss (3:1) for violets from bog areas.
- Keep them moist in mist system or in a shaded, covered area.



***V. chamissoniana* subsp. *tracheliifolia* seeds – Maui — F&KS**

OUTPLANTING

- Your violets will be ready to plant out in one or two years, when they are growing strong and have outgrown a 1–2-gallon pot.
- Choose a site according to their natural habitats. For example, bog plants should be planted in moist soil with partial shade, and the drier mesic plant species will do better in full to partial sun with well-draining soil amended with cinder and a small amount of 8-8-8 NPK fertilizer.
- Water them in, and then water when they are dry until they are well established; be careful because the taller plants have brittle stems that can break easily.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your *Viola*; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants.
- Red spider mites attack the undersides of leaves; to remove them, spray with horticultural oil weekly; water the plants first to reduce any stress.
- Slugs or snails may eat the leaves and the young fruit; if you discover them, apply slug bait or pick them off by hand.

VISCACEAE
(MISTLETOE FAMILY)

GENUS:
Korthalsella

HAWAIIAN NAMES:
Hulumoa; kaumahana

COMMON NAME:
Hawaiian mistletoe

SPECIES	STATUS	HAWAIIAN RANGE/HABITAT
K. complanata	—	ind (HI exc. Ni, Ka) mesic to wet forests
K. cylindrica	—	end (HI exc. K, Ni, Ka) dry forests to bogs
K. degeneri	R	end (O) diverse mesic forests
K. latissima	—	end (K, O, H) wet forests
K. platycaula	—	ind (K, O, L, M) diverse mesic forests
K. remyana	—	end (HI exc. Ni, Ka) dry forests to bogs



***Korthalsella complanata* on a *Pittosporum* – Kaua'i — KRW**

V

Shady

Range
Endemic or Indigenous[1]

Description
hemiparasitic subshrub

Propagation
seeds

1: Range differs for each species.

GENERAL DESCRIPTION

Hawaiian native *Korthalsella* are hemiparasitic subshrubs that live partly dependent on the branches of host plants. They have specialized roots that penetrate into the tissues of another plant for nutrients. In the wild they are found growing generally on native woody plants such as *Acacia*, *Metrosideros*, *Diospyros*, *Myrsine*, *Sapindus*, and *Nestegis*. These small evergreen subshrubs are easily recognized by their curious growth habit. They have circular or flattened stems, and many joints with numerous smaller branches on top. The tiny inconspicuous pairs of scale-like leaves grow from the internodes, as do the small flower clusters and pear-shaped fruits. The tiny fruits contain one flat seed that is explosively ejected when

it is mature. Its target is another branch or host plant. I have never had the pleasure of propagating this genus, but my experience indicates that if you collect mature viable seeds and place them securely under the bark of a host plant and keep the area moist, they will eventually germinate and grow into the enchanting Hawaiian mistletoe.

Entire Range: *K. complanata* is indigenous to the Hawaiian Islands and Henderson Islands; *K. platycaula* is indigenous to Tahiti, Marquesas, Austral, and the Hawaiian Islands; the remaining *Korthalsella* species are endemic to all of the main Hawaiian Islands

Wild Habitat: Dry, mesic, wet, diverse mesic forests, and bogs

Habit: Brittle, partially parasitic evergreen subshrub, green and photosynthetic, grows with woody host plant

Mature Height: 1–5 dm height

Stem/Trunk: Strongly jointed green stems, branches cylindrical to flat

Leaves: Leaves are reduced small scales, simple, opposite, with entire margins and no stipules

Inflorescence/Flower: Flower is minute, greenish-yellow, with no flower stalk; it is wind- or insect-pollinated, unisexual; each flower has a bract beneath it; male and female flowers are intermixed within a continuous band around the stem; there is no calyx, the corolla is three-lobed, and the ovary is inferior in female flowers; flowers occur in clusters in the leaf axils, surrounded by a patch of dark hairs, the flower groups become extensive, or many-flowered

Fruit: The fruit is fleshy, shaped like a baseball bat or pear; it has a persistent corolla, and is explosive

Seed: Seeds lack a seed coat; they are capped at one end with a viscid-sticky tissue; they contain chlorophyll, and the endosperm is starchy (Wagner et al. 1990)



***K. complanata* seeds—F&KS**

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect fruits when they are mature, yet before they have ejected their seeds, or collect a small piece of stem with several fruits on it.
- Keep them dry in a paper bag until they can be started.
- Start the seeds fresh with no pretreatments necessary.
- Put the fruits or stem into a bowl, and remove the small, flat seeds from the fruits by hand.
- Place them securely under a piece of bark of a live tree; lightly moisten the area with water, so as not to dislodge the seeds.
- Keep the area moist.
- This is just a guess of how to propagate this genus; I cannot wait to experiment with these seeds myself on *Acacia koa* and *Metrosideros* trees in my yard.

ZYGOPHYLLACEAE

(CREOSOTE BUSH FAMILY)

GENUS:

Tribulus

HAWAIIAN NAMES:

Nohu; nohunohu

COMMON NAMES:

Caltrop; puncture vine

SPECIES	STATUS	HAWAIIAN RANGE
T. cistoides	—	ind (Kl, Le, Hl) dry coastal habitats

Z

Full Sun

Range
Indigenous

Description
herb

Propagation
seeds



***Tribulus cistoides* flowers — DB**

GENERAL DESCRIPTION

The weedy nohu is a low, sprawling, perennial herb with many branching stems 3 feet long. It occurs commonly in hot, dry coastal habitats. The small, paired leaflets are opposite and 1–3 inches long, with shiny, microscopic hairs that prevent the leaf surface from drying out from harsh coastal winds. Nohu has charming yellow saucer-shaped flowers, 1 inch across, that are borne singularly on long stems above the foliage. These ripen into round spiny fruits that easily stick to coastal birds' feathers. Each fruit has three to five separate chambers that split when mature. Each contains one tiny egg-shaped seed. The name *Tribulus* is derived from the Latin word *tribolos*, meaning a three-pointed weapon, and here it refers to the barbed fruits.

Entire Range: Nohu is indigenous to the old world, it is pantropical in maritime habitats, in Hawai'i it occurs on all of the Hawaiian Islands except Gardner Pinnacles and Necker

Wild Habitat: Coastal and maritime habitats

Habit: Prostrate to upright perennial herb



T. cistoides habitat – albatross Midway Is. —F&KS

Mature Height: Several m long

Stem/Trunk: Stems are diffusely branched, covered with fine hairs

Leaves: Leaves are opposite, pinnately compound, 3–10 cm long, leaflets five to ten pairs, oblong to elliptic, about 18 mm long by 8 mm wide; both leaflet surfaces are covered with hairs; stipules

Inflorescence/Flower: Flowers are perfect, radially symmetrical, solitary, growing on flower stalks from the leaf axils, with five sepals, and the five petals are bright lemon yellow, ten stamens, five stigmas

Fruit: Fruit is a schizocarp, about 10 mm in diameter, spiny with three to five chambers, splitting when ripe into each one-seeded compartments

Seed: Seeds are small, oblong, with a membranous seed coat and the endosperm absent (Wagner et al. 1990)

PROPAGATION AND CULTIVATION

SEEDS

- To propagate by seed, first collect the spiny fruit when it is dry and brownish; keep it dry in a paper bag until cleaned.
- Carefully break open the fruits with a small hammer to avoid getting pricked by the spines; remove the small seeds.
- To pretreat, soak the seeds in tap water for one to two hours.
- Surface sow the seeds onto a mix of 3 parts perlite to 1 part vermiculite (3:1), and water them in.
- Keep the flat protected from heavy rains and strong drying winds, and water them when it is dry.

GERMINATION

- Germination of all viable seeds will take two weeks to three months.
- Wait for two to four true leaves to form before transplanting them into a well-draining mix amended with some rinsed beach sand (or add a small amount of dolomite lime to the mix).
- Keep them in partial shade at first, and then move them into full sun.
- Repot them into larger pots in two to three months.

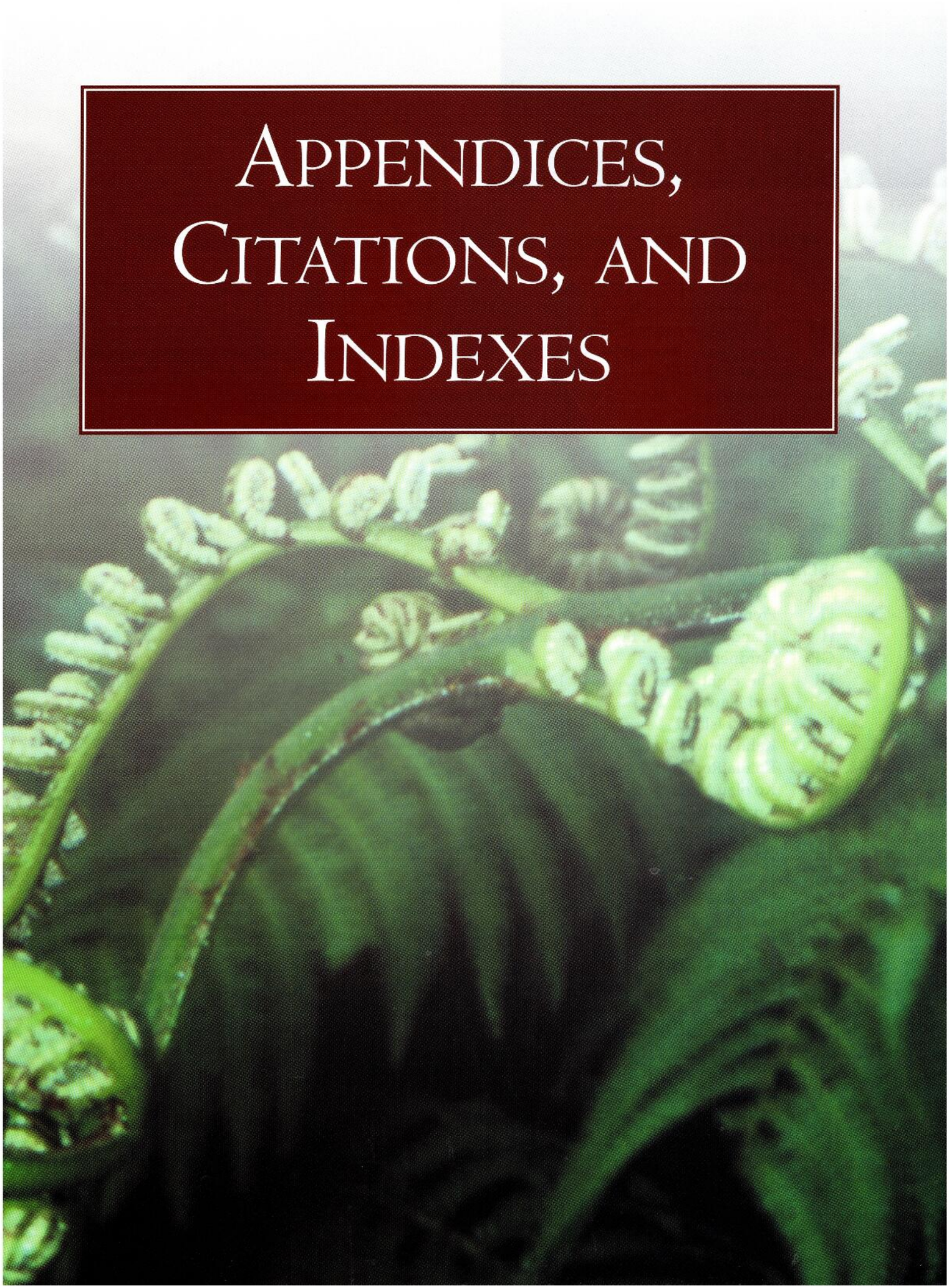
OUTPLANTING

- Your nohu plants will be ready to plant out in six months, when they have outgrown a 6-inch pot.
- Choose a site with full sun and well-draining soil; amend it with beach sand or cinder.
- Water your plants in, then water only during prolonged periods of drought.
- This is an excellent beach ground cover with its bright yellow flowers. Do watch out for the spiny fruits that may injure bare feet.

PESTS

- Ants and their associated pests (scales, mealybugs, thrips, and aphids) can infest your nohu; these sucking insects will feed on the plant juices. Use a systemic pesticide to control them and bait for the ants according to the protocols for ants (p.40).

Appendices, Citations, and Indexes



APPENDIX I

ABBREVIATIONS USED IN PLANT FAMILY DESCRIPTIONS (WAGNER ET AL. 1999)

Range

End Endemic: naturally occurring only in a specified area, such as a single island, or only in the Hawaiian Archipelago and nowhere else on earth
Ind Indigenous: native to Hawai'i and other regions
Pol Polynesian introduction: about thirty plant species brought by Polynesian voyagers to Hawai'i
Native Native: Indigenous or endemic species
Nat Naturalized: a nonnative species that becomes successfully established

Status

AS	Apparently secure	**R**	Rare
E	Endangered	**T**	Threatened
Ex, ex.	Extinct in the wild	**V**	Vulnerable
exc.	Except		

ISLANDS AND ATOLLS

EM East Maui
FF French Frigate Shoals (incl. Tern and other islands)
H Island of Hawai'i; the Big Island
GP Gardner Pinnacles
HI The eight main Hawaiian Islands (Ni'ihau, O'ahu, Moloka'i, Lāna'i, Maui, Kaho'olawe, and Hawai'i)
K Kaua'i Island
Ka Kaho'olawe Island
Kl Ka'ula Rock
Ko Ko'olau Mountains, O'ahu
Ku Kure Atoll (incl. Sand and Green Islands)
L Lāna'i Island
La Laysan Island
Le Lehua Island
Li Lisianski Island
M Maui Island
Mi Midway
MI Molokini Island
Mo Moloka'i Island
N Nihoa Island
NWHI Northwestern Hawaiian Islands
Ne Necker Island
Ni Ni'ihau Island
O Oahu Island
PH Pearl and Hermes Atoll
Wa Waianae Mountains, O'ahu
WM West Maui

APPENDIX II

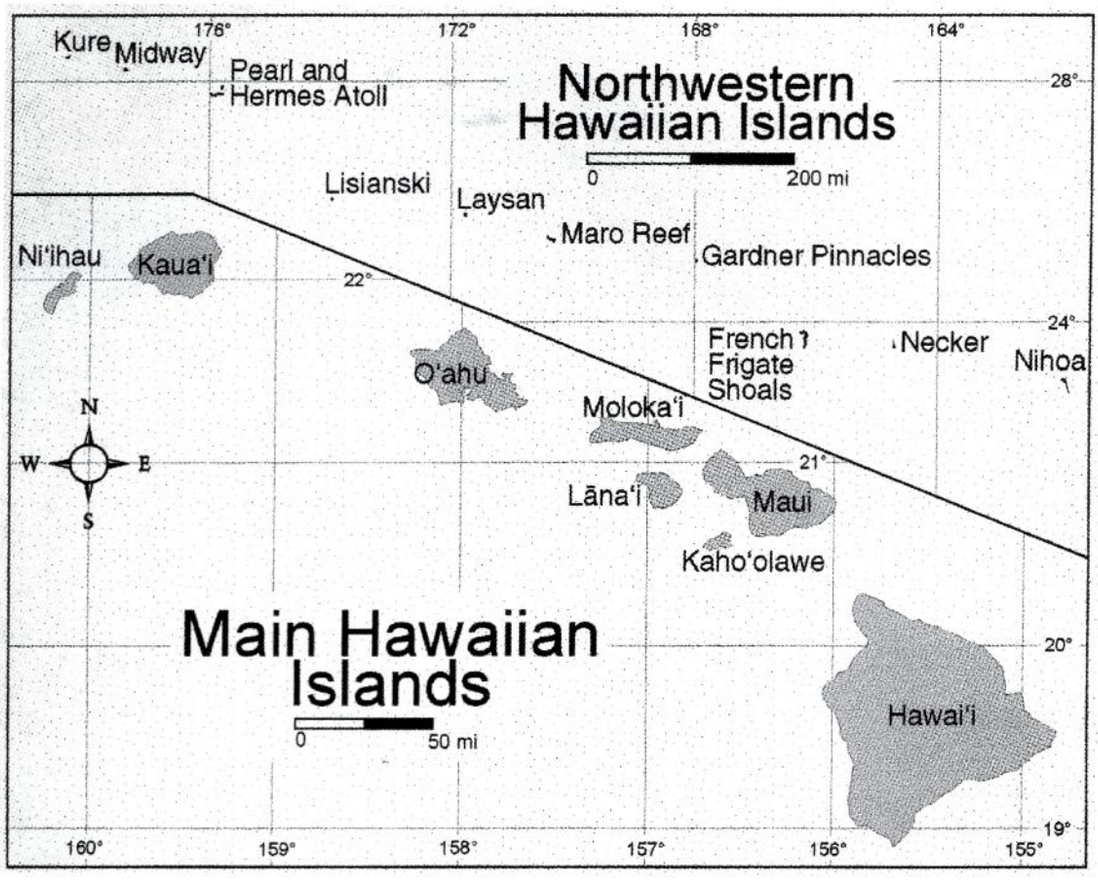


Plate 1. Map of the Hawaiian Archipelago where native Hawaiian taxa occur, including Ni'ihau, Kaua'i, O'ahu, Moloka'i, Lāna'i, Maui, Nihoa, and Hawai'i (map courtesy of Brad Evans, Bishop Museum, Honolulu, Hawai'i).

APPENDIX III

PESTS AND DISEASES

Common Name(s)	Scientific Name
Agromyzidae fly stem miner	*Melanagromyza splendes*
Ant	(family): Dolichoderinae, Myrmicinae
Aphid	(superfamily): Aphidoidea
Black twig borer	*Xylosandrus compactus*
Chicken	*Gallus domesticus*
Chinese rose beetle	*Adoretus sinicus* Burmeister
Fruit fly	(family): Tephritidae, (order): Diptera
Fungal leaf spots	*Colletotrichum gloeosporioides*
Goat	*Capra hircus*
Hibiscus snow scale	*Pinnaspis strachani*
Hibiscus erineum mite	*Aceria hibisci* (*Nalepa*)
Leaf miner	(family): Agromyzidae, *Liriomyza* spp.
Leafroller	(family): Torricidae: *Archips* spp.
Mealybug	*Planococcus* spp. *Pseudococcus* spp.
Mouse	*Mus musculus*
Painted lady caterpillar	*Vanessa cardui*
Pig	*Sus scrofa*
Powdery mildew	*Spaerotheca* spp., *Erysiphe* spp.
Rat	*Rattus exulans, R. norvegicus, R. rattus*
Root fungus	*Phytophthora* spp., *Phthium* spp., *Rhizoctonia* spp.
Root-knot nematode	*Meloidgyne incognita*
Root mealybug	*Planococcus* spp. *Pseudococcus* spp.
Rust	*Phragmidium* spp.
Scale	(subfamily): Coccoidea
Seed weevil	(family): Bruchidae
Silverleaf Whitefly	*Bemisia argentifolii*
Slug	*Vaginulus plebeius, Arion* spp.
Snail	*Achatina fulica*
Spider mites	*Tetranychus* spp.
Spittle bug	*Aphrophora alni*
Sugarcane borer	*Diatraea saccharalis*
Sweet potato weevil	*Cylas formicarius* (Fabricius)
Toad	*Bufonidae*
Thrip	*Heliothrips haemorrhoidalis*
Two-spotted leafhopper	*Sophonia rufofascia*
Whitefly	*Trialeurodes vaporariorum*

APPENDIX IV

GUIDE TO ABBREVIATIONS IDENTIFYING PHOTOGRAPHERS

JA	Jesse Adams
SB	Steve Bergfeld
HB	Heidi L. Bornhorst
DB	David S. Boynton
GDC	Gerald D. Carr
CC	Dr. Colleen Carroll
MC	Dr. Melany Chapin
M. Clark	Michelle Clark, USFWS
PC	Captain Paul Clark – Save Our Seas
SC	Dr. Sheila Conant
JD	Jim Denny
SG	Sean Gleason, M USGA-HI. PTA
RH	Robert Hobdy
JJ	Jim Jacobi
KJ	Kathleen Johnson
CHL	C. H. Lamoureux
KLR	Kerin Lilleeng-Rosenberger
GKL	G. K. Linney
DL	Dr. David H. Lorence
KM	Ken Marr
TJM	T. J. Motley
JO	John Obata
SP	Steve P. Perlman
DR	Dr. Diane Ragone
GR	George Rosenberger
F&KS*	Forest and Kim Starr, USGS
NT	Natalia Tangalin, NTBG
PT	Dr. Peter Townsend
UK	unknown
AW	Art Whistler
KRW	Ken R. Wood
RY	Randy Yokoyama

* I want to recognize Forest and Kim Starr for their valuable contribution to the conservation of Hawai'i's native ecosystems and their generosity with the many beautiful images they share with the public.

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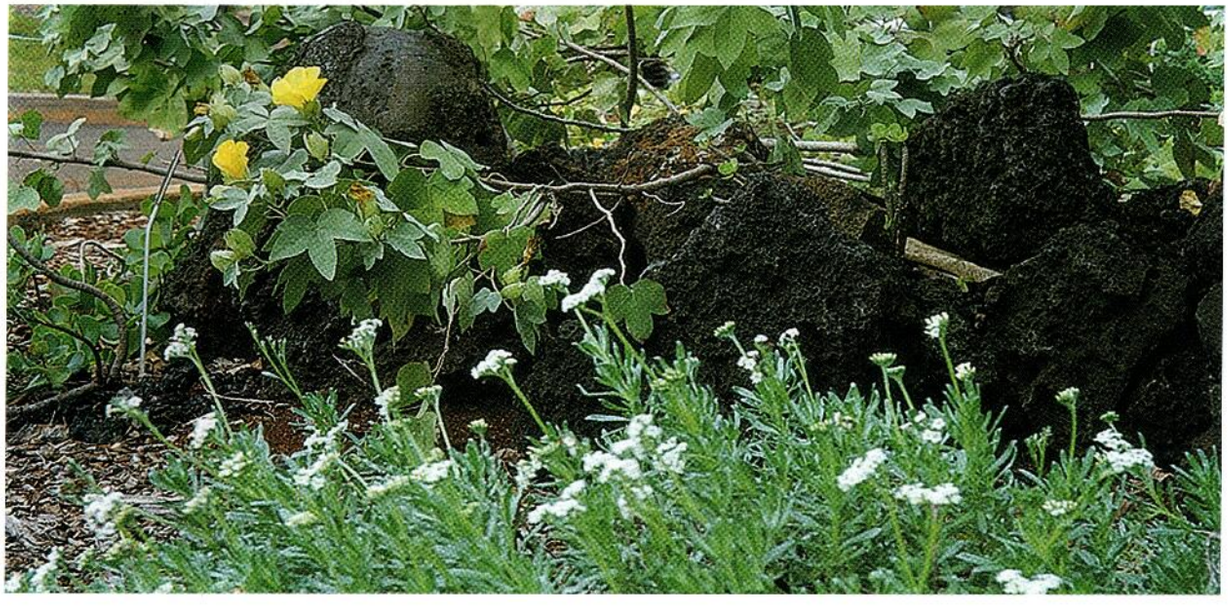
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ABOUT THE AUTHOR

Kerin Lilleeng-Rosenberger immediately recognized the special nature of Hawai'i when she arrived in Hilo in 1968. Her fascination with Hawaiian plants, sparked by working with ti (Cordyline) cuttings, increased when she volunteered at the National Tropical Botanical Garden (NTBG) on Kaua'i. There, some of the finest horticultural experts taught her grafting, air layering, and other propagating methods and specialized horticultural techniques. Her natural green thumb and keen interest quickly earned her the position of being in charge of propagation for the NTBG volunteer plant site.

In 1988 Kerin volunteered for a community outreach program created at NTBG to increase public awareness by providing native Hawaiian plants to the community. She earned a reputation of being capable of growing "hard to grow" unknown plants.

A grant from the John D. and Catherine T. MacArthur Foundation was awarded to NTBG to create a resource center for understanding how to propagate native Hawaiian plants. The result of this grant, the Hawai'i Plant Conservation Center (HPCC), gave Kerin the opportunity to unlock the methods needed to propagate well over 800 species of native Hawaiian plants. She tried to mimic nature to figure out how to break dormancy, initiate germination, and successfully grow healthy seedlings and plants. Her work with the HPCC provided much of the knowledge included in this book.

Kerin then took a position as research horticultural specialist with the Research Corporation of the University of Hawai'i (RCUH). Her work involved the cycle of collecting seeds, propagating them, and then planting them back out into their wild habitats. By experimenting with the plants at different elevations, Kerin increased her knowledge of what was possible when working with plants of various altitudes and vegetation regions.



Kerin in her nursery 2005—GR

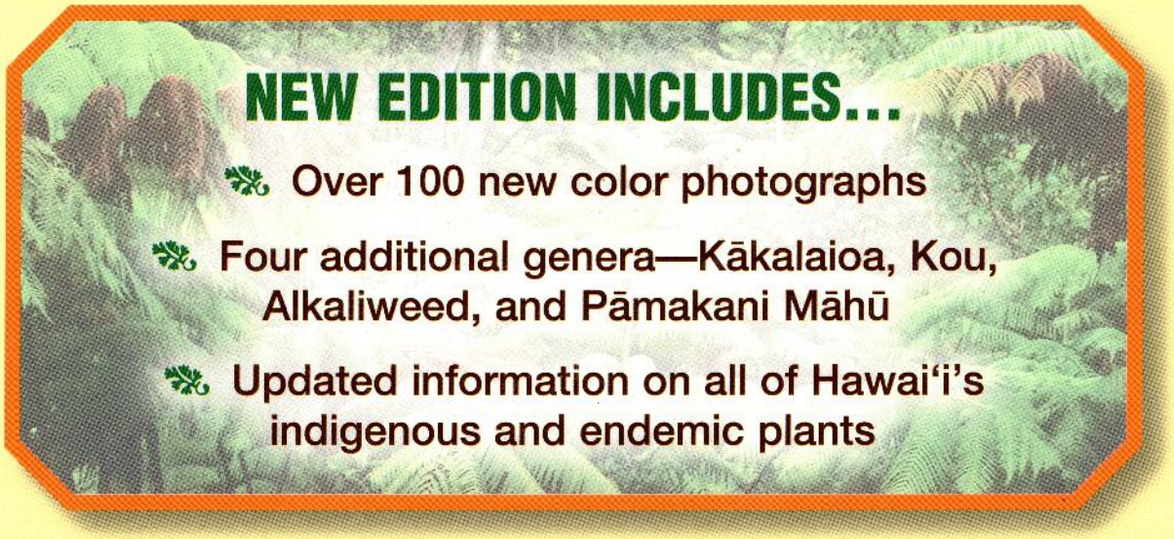
Kerin has worked with the worldwide botanical community on various research efforts, has been the subject of several national and international articles on her unique knowledge, and has held classes for volunteers, the scientific community, specialists, and the general public. Today she is still considered to be the world leader in native Hawaiian plant propagation. Her enthusiasm for sharing her knowledge of native plants with others has led to the publication of this book so that everyone and anyone can appreciate and enjoy growing the keiki o ka 'āina (children of the land).

AWARDS:

Article: September 1997, United Airlines HEMISPHERES magazine Flower Power: Kerin Lilleeng-Rosenberger by Margaret A. Haapoja.

In March 11, 1998 in observance of Women's History Month, The Garden Club of Honolulu recognized me for my outstanding contribution to Horticulture and Conservation in Hawai'i.

2006 my book won the Ka Palapala Po'okela Awards for Excellence in Natural Science from the Hawai'i Book Publishers Association.



As public awareness has grown of Hawai'i's unique and threatened botanical heritage—89% of the Islands' native plants are found nowhere else in the world—interest in helping these species to thrive by planting them in backyards and landscaping projects has blossomed. But native plants are different from exotics. They propagate, bloom, and fruit in accordance with Hawai'i's natural climate and on their own schedules. The knowledge of how to grow and care for these special plants has been hard to come by, passed on mostly by word of mouth, one plant at a time.

Growing Hawai'i's Native Plants is the consolidated resource that provides all the information needed to identify and propagate native Hawaiian plants. Much of the knowledge found here, gathered from more than a decade of research, can be found nowhere else.

Using a clear, easy-to-read format, *Growing Hawai'i's Native Plants* contains an extensive, thoroughly researched entry for each of the 1,386 true existing native Hawaiian species. For each entry there is a species description, information on provenance, growing methods, germination rates, pest and disease control, and most importantly, directions for outplanting.

Growing Hawai'i's Native Plants is a one-stop reference work for scientists and nursery owners, conservationists and backyard gardeners alike. Tropical gardeners and conservationists around the world will also find this volume a valuable addition to the comparatively small literature on tropical plant propagation and conservation.

Included are more than 500 high-quality color images and a foreword by renowned botanist Sir Ghillean Prance, former director of the Royal Botanic Gardens at Kew and scientific director of the Eden Project.

ABOUT THE AUTHOR

Kerin Lilleeng-Rosenberger immediately recognized the special nature of Hawai'i when she arrived in Hilo in 1968. Lilleeng-Rosenberger became fascinated with Hawaiian plants. Her knowledge of native plants grew as she worked at the National Tropical Botanical Garden (NTBG), the Hawaii Plant Conservation Center (HPCC), and held the position of horticultural specialist with the Research Corporation of the University of Hawai'i (RCUH).

Lilleeng-Rosenberger has worked with the botanical community from across the globe on various research efforts. She has been the subject of several national and international articles on her unique knowledge, and has held classes and courses for volunteers, the scientific community, specialists and the general public. Today she is considered to be a world leader in native Hawaiian plant propagation.

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